BOSTON PUBLIC LIBRARY
3 9999 06317 529 1

№ *9388.173A3

1950-
1954

THE TRVSTEES OF THE PVBLIC LIBRARY
LVX
OMNIVM
CIVIVM
OF THE CITY OF BOSTON
1852 · 1878

GIVEN BY

U. S. SUPT. OF DOCUMENTS

Dal

* [illegible] A3

1950-54

ANNUAL REPORT

Bureau of Public Roads

FISCAL YEAR 1950

Central Expressway in Dallas, Texas

Cupie. [illegible]

DEPARTMENT OF COMMERCE

BOSTON PUBLIC LIBRARY

March 14, 1956
*9388.173A3
U. S. SUPERINTENDENT OF DOCUMENTS 1950-54
~~JAN 29 1951~~

CONTENTS

Page
Factors affecting progress 1
The Federal-aid program 2
Classes of Federal-aid work 2
Status of work at end of fiscal year 4
The National System of Interstate Highways 4
Improvement of urban highways 5
Work on outstanding projects 8
The Federal-aid highway system 14
Joint planning of location of highways and airports 15
Secondary or farm-to-market roads 15
Typical farm-to-market road improvements 16
Highway improvement under direct supervision of the Bureau 19
Repair of war-damaged highways 23
Repair of flood-damaged roads 24
Hawaii war and emergency damage program 24
Rehabilitation of Philippine highways 25
Aid to Turkey in highway improvement 26
Foreign visitors 28
The President's Highway Safety Conference 28
The Inter-American Highway 29
Highway needs studies 31
Highway transport research 31
Financial and administrative research 37
Hydraulic research 41
Physical research 42
Appendix, tables 1–19 51

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 25 cents

ANNUAL REPORT OF THE BUREAU OF PUBLIC ROADS

Factors Affecting Progress

MARKED PROGRESS in the improvement of highways of all kinds was made in the fiscal year 1950,[1] both in the Federal-aid program and that conducted independently by the States and local agencies. Use of the highways, congestion, and public demand for better facilities reached all-time peaks. Highway organizations responded by making improvements at a rate limited only by funds available and the time required in taking the numerous steps necessary before construction can begin on expressways and other large projects.

A large mileage of modern and fully adequate highways was placed in service with great benefit to the economy of the Nation. Improvements were made at locations where the worst conditions had existed, but many miles of adjacent highways remained in bad condition. Accomplishment with available means was excellent, but it cannot be said that satisfactory progress was made in overcoming highway deficiencies which will cost, according to various estimates, from $42 to $47 billion.

Public demand for a more rapid rate of improvement resulted in increases in gasoline taxes in eight States and in authorization of increases in two States that became effective after the end of the year.

In the calendar year 1949 motor vehicles increased by 3½ million to a total of 44,670,000, or more than twice as many as in 1926. In each month of the fiscal year highway travel exceeded all previous records and totaled 424 billion vehicle-miles for the year. The added increments of vehicles and travel on already overcrowded highways produced intolerable conditions on urban arteries and approaches, and added to the hazards of travel on all substandard highways. They also produced additional motor-vehicle revenues with which to offset the marked increases in highway costs during the postwar period.

In general, supplies of materials and labor were adequate, and in some small areas there was emphasis on highway work to provide needed employment. Competition among contractors for highway construction jobs was more pronounced. Sixty-nine hundred firms bid on one or more Federal-aid jobs. Of the 1,926 successful bidders on 4,600 jobs (some had several jobs), 400 were considered newcomers to Federal-aid work since they had not been awarded a contract in the preceding 5 years.

The decline in highway construction costs, which started in the middle of the preceding fiscal year, continued throughout the entire year. The cost index on a 1940 base, with correction for increased design requirements, dropped from its peak of 223.5 in the second quarter of fiscal year 1949 to 201.1, 196.4, 190.2, and 189.3 in the successive quarters of the fiscal year 1950. Increased competition among contractors, improved efficiency in contractors' operations, and increased productivity of labor and equipment accounted for the decline. The slight drop in the last quarter indicated a tendency for bid prices to level off.

---

[1] The fiscal year extended from July 1, 1949, to June 30, 1950.

Conditions generally were conducive to a more satisfactory rate of progress than had been possible in preceding fiscal years. State highway departments awarded contracts for 54,000 miles of highways, and for several thousand bridges and grade-crossing elimination structures, at a cost of $1.4 billion (fig. 1). Federal-aid highway improvement constituted a large segment of the general program, as described in the following pages.

The Federal-aid Program

Highway improvement in cooperation with the States was supported by an authorization of $450 million for the fiscal year and by remaining portions of previous authorizations.

A new record high was reached during the fiscal year in the volume of all classes of Federal-aid highway projects brought to completion. Improvements completed had a total length of 21,030 miles. This is almost identical with the mileage completed during the prior year and was exceeded slightly by mileages completed during the fiscal years 1934 and 1937, but the greater emphasis on relief of traffic congestion in urban areas, coupled with increasing attention to development of the interstate system, has resulted in the construction of a higher percentage of multiple-lane highways and bridges than in previous years. Thus, the total traffic service provided by the more recently completed improvements is unquestionably of a higher order than ever before achieved.

Improvements completed were as follows: On the Federal-aid highway system outside of cities (principal intercity highways), 5,914 miles of highways and 1,163 bridges; on urban portions of the Federal-aid highway system, 779 miles of highways and 353 bridges; and on secondary or farm-to-market roads, 13,515 miles of highways and 1,631 bridges. Accomplishments in the elimination of hazards at railroad-highway grade crossings included the elimination of 154 crossings, reconstruction of 48 inadequate grade-separation structures, and the protection of 414 crossings by flashing-light signals or other appropriate safety devices.

The Federal-aid program continued to gain momentum, extending a trend that began at the end of the war. Contract awards during the year for 21,799 miles of construction included numerous major undertakings that had been under consideration for 2 or 3 years. Work put in place amounted to 97 percent of the $450 million authorization for the year. As the year ended construction was in progress or was scheduled to begin soon on 22,876 miles of highways and streets.

New projects involving construction of 26,659 miles were programed during the year. All but a few States were programing projects to be improved with funds provided by the $450 million authorization for the fiscal year 1951.

At the end of the year Congress was considering legislation authorizing funds for continuation of the Federal-aid highway program beyond the fiscal year ending June 30, 1951.

Detailed statistical information showing accomplishments during the year and the status of the program at the year's end is contained in tables in the appendix.

Classes of Federal-aid Work

The Federal Government provides funds to assist the States in improvement of three general classes of highways.

The Federal-aid primary system.—Improvement of the main highways included in the primary system has proceeded without interruption since the

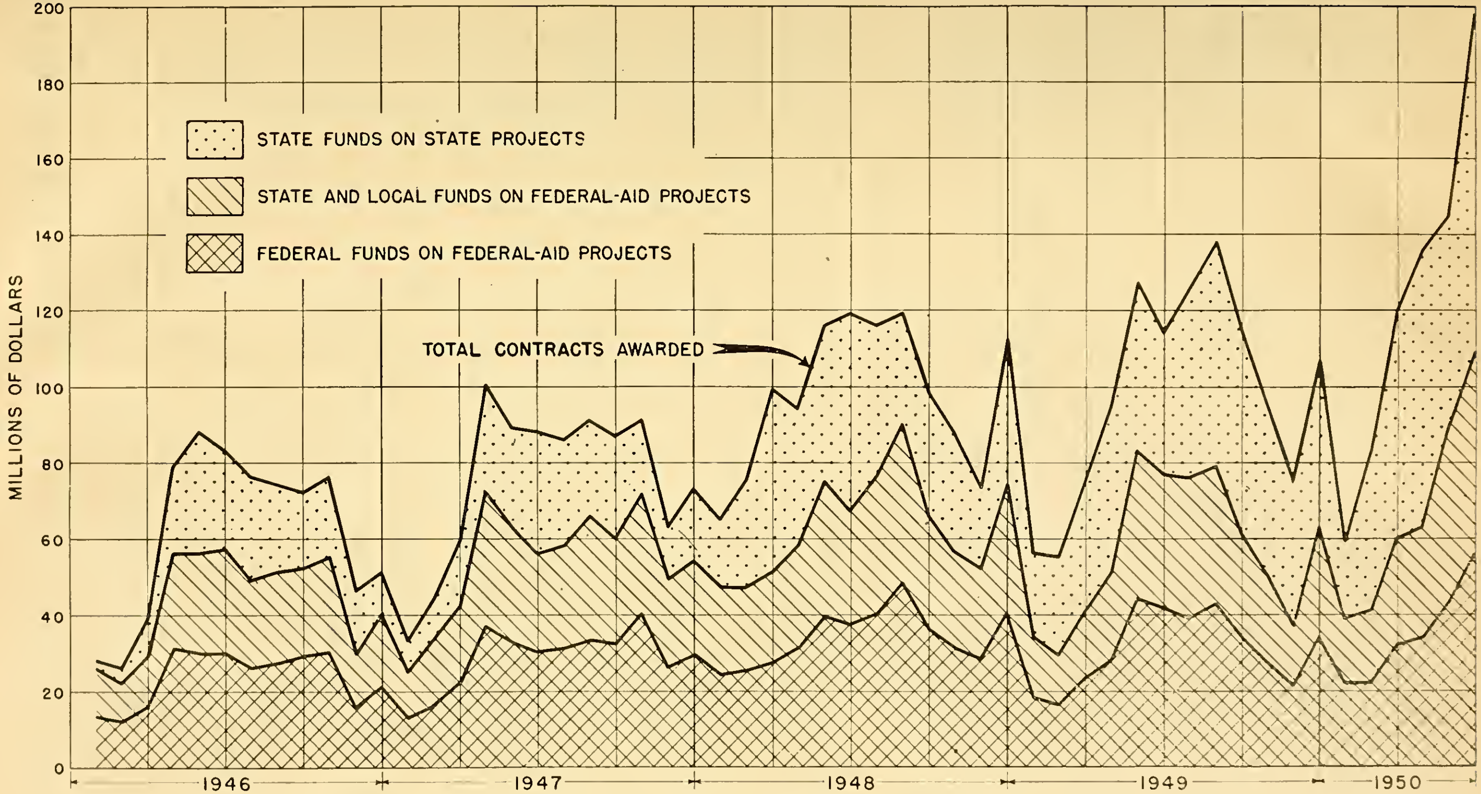


Figure 1.—Highway construction contracts awarded by State highway departments.

designation of the system in 1921. Under postwar legislation, 45 percent of authorized Federal-aid funds have been assigned for improvements to the primary system. Primary funds of $202.5 million were authorized for each of the fiscal years 1950 and 1951. Nearly one-fourth of the postwar funds allotted to approved primary projects are for improvements to the National System of Interstate Highways. This system, which is limited by law to 40,000 miles, is composed of the most important primary Federal-aid highways.

The Federal-aid secondary system.—By providing for the allotment of 30 percent of authorized Federal-aid funds to the improvement of secondary and feeder roads, substantial recognition is given to the Federal interest in this class of improvement. Secondary funds of $135 million were authorized for each of the fiscal years 1950 and 1951.

The Federal-aid urban system.—To aid the cities in providing the modern highway facilities essential to the elimination of traffic congestion, 25 percent of postwar Federal-aid authorizations have been designated for improvements to main routes in urban areas. Urban funds amounting to $112.5 million were authorized for each of the fiscal years 1950 and 1951. Primary system funds are also available for improvements in urban areas. Almost one-half of the postwar funds allotted to approved urban projects are for urban improvements on routes of the National System of Interstate Highways.

Status of Work at End of Fiscal Year

Postwar Federal-aid funds of $2,322,500,000 had been apportioned to the States by the close of the fiscal year, for the fiscal years 1946, 1947, 1948, 1950, and 1951. In terms of Federal funds the status of projects financed from these funds was as follows: Total programs approved, $2,077,060.103; total plans approved and construction authorized, $1,675,695,819; projects placed under contract, $1,574,242,129; projects placed under construction, $1,521,125,408; work done, $1,293,893,000; and projects completed, $1,049,270,499. Apportioned postwar funds not yet programed to projects amounted to $245,439,897.

Figures 2 and 3 show graphically the progress made in utilizing the postwar primary, secondary, and urban funds separately, and the three funds combined.

All postwar projects programed to June 30, 1950, had a total cost in Federal and State matching funds of $4,130,249,283. Of this, projects costing a total of $3,129,609,030 had been placed under contract, and the estimated total cost of work done was $2,566,299,000. Projects brought to completion had a total cost of $2,072,407,454.

Although mileage figures do not give a complete measure of the physical volume of work involved, they are useful in comparing accomplishments with mileages included in the Federal-aid systems. Postwar projects programed to June 30, 1950, provide for improvements to 100,399 miles of highways and streets. In terms of total system length, the mileage of primary and urban improvements amount to nearly 14 percent of the combined primary and urban Federal-aid system mileage, and the secondary road projects amount to almost 17 percent of the secondary Federal-aid system mileage.

Of the total mileage included in approved postwar programs, 62 percent or 61,788 miles had been completed. An additional 21,514 miles were under construction or approved for construction at the close of the fiscal year.

The National System of Interstate Highways

More improvements of a major character were made on the main highways of the country that compose the National System of Interstate Highways than in any previous year. The number of controlled-access expressways, structures to eliminate crossings at grade with rail lines and with other highways, and four-lane divided highways under way increased greatly. Typical projects are described in following pages, in the section on work on outstanding projects.

The interstate system, as designated by the States in cooperation with Federal authorities, includes 37,800 miles, of which 31,831 miles are in rural areas and 5,969 in urban areas. Approximately 2,200 miles of the 40,000 miles authorized were reserved for connections through cities and circumferential routes around them. No changes have been made in the general location of the system as approved August 2, 1947. The original designation diagramed the connections to be provided among the larger population centers, and left the detailed locations for determination as improvements were made. Every State was engaged in making detailed locations for projects to be undertaken in the near future.

The report for the fiscal year 1949 stated that all but 1,900 miles of the system in rural areas and 398 miles in urban areas required improvement to bring the routes up to standards recommended for the volumes of traffic then existing. Cost of making required improvements was estimated at $11,266,000,000.

In comparison with this estimate of need already existing, progress made during the fiscal year is not impressive. Projects completed with Federal assistance totaled 979 miles at a total cost of $168,507,578, of which $87,893,149 were paid with Federal funds. A much larger amount was under construction or approved for construction at the end of the year—1,467 miles at a total cost of $351,745,663, of which $170,139,731 were Federal funds.

Table 11 of the appendix shows the status of the improvement program by States. Federal expenditures on the system are made from funds provided for the Federal-aid primary system and for urban highway improvements. Therefore, table 11 shows mileage and funds also included in tables relating to the Federal-aid primary system and urban improvements.

Public dissatisfaction with the congestion, delays, and dangers on main routes was an important factor in producing increased momentum of the improvement program. As the numerous well-designed expressways and other arterial improvements under construction are completed and demonstrate to the public their great advantages, the pressure for more such improvements will be increased. Newspapers of one State explained the decrease in business of resort areas as due to new express highways in two adjacent States that made other resort areas more attractive and accessible. Adverse effects of lagging highway improvement on business led to much action in past road development and will undoubtedly do so in the modernization of the interstate system.

Improvement of Urban Highways

During the fiscal year the urban highway program attained the full speed contemplated in Federal legislation, since allotments of Federal funds were more than equal to the current rate of apportionments. Funds apportioned to the States specifically for urban improvements for each of the fiscal years 1950 and 1951 amounted to $108,281,250. Such funds assigned to projects programed during the year amounted to $123 million; for projects for which plans were approved, $104 million; and for projects placed under construction, $110 million. In many States additional funds were expended by cities, counties, and States on major urban improvements. In some States the cities or counties, or both, provide funds for the purchase of right-of-way which in urban work often represents a large percentage of the total cost. Often Federal aid is used on only one section of an improvement and other sections are constructed simultaneously without Federal assistance.

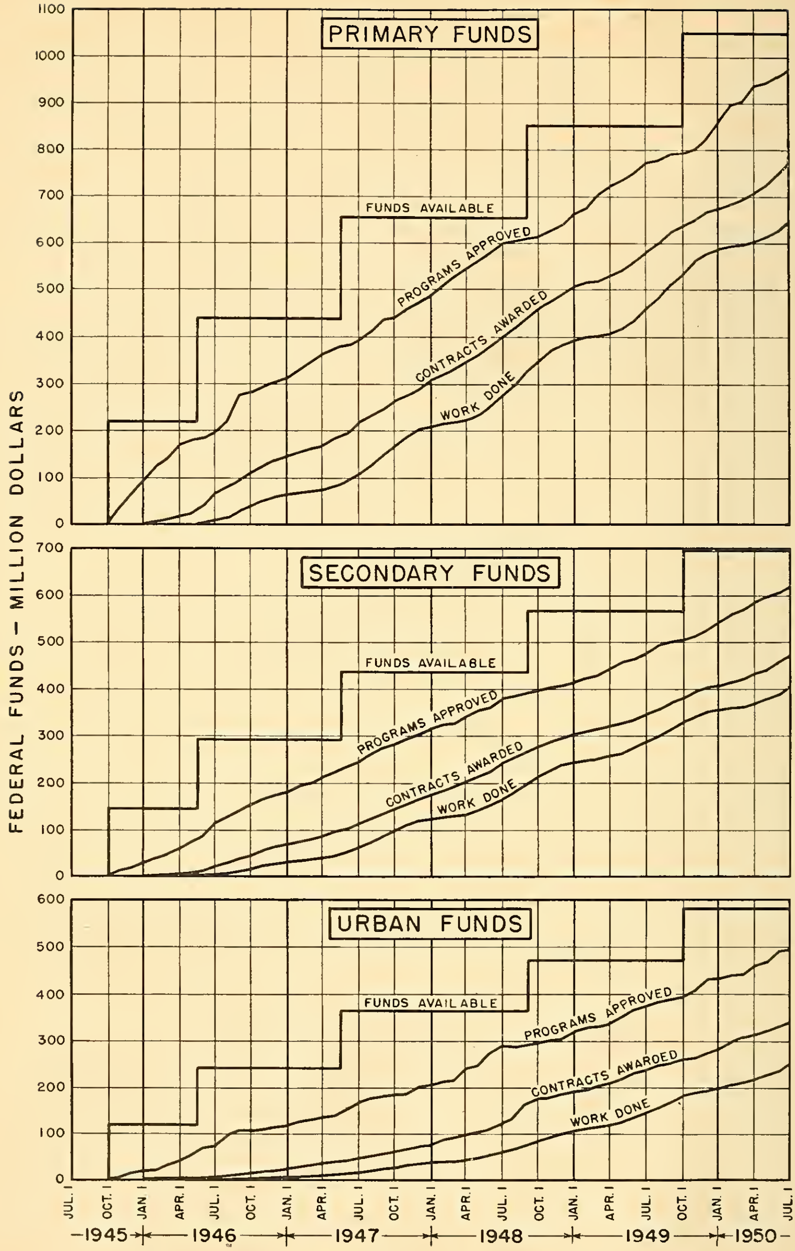


Figure 2.—Progress in approving programs, awarding contracts, and constructing projects financed with postwar Federal-aid primary, secondary, and urban funds.

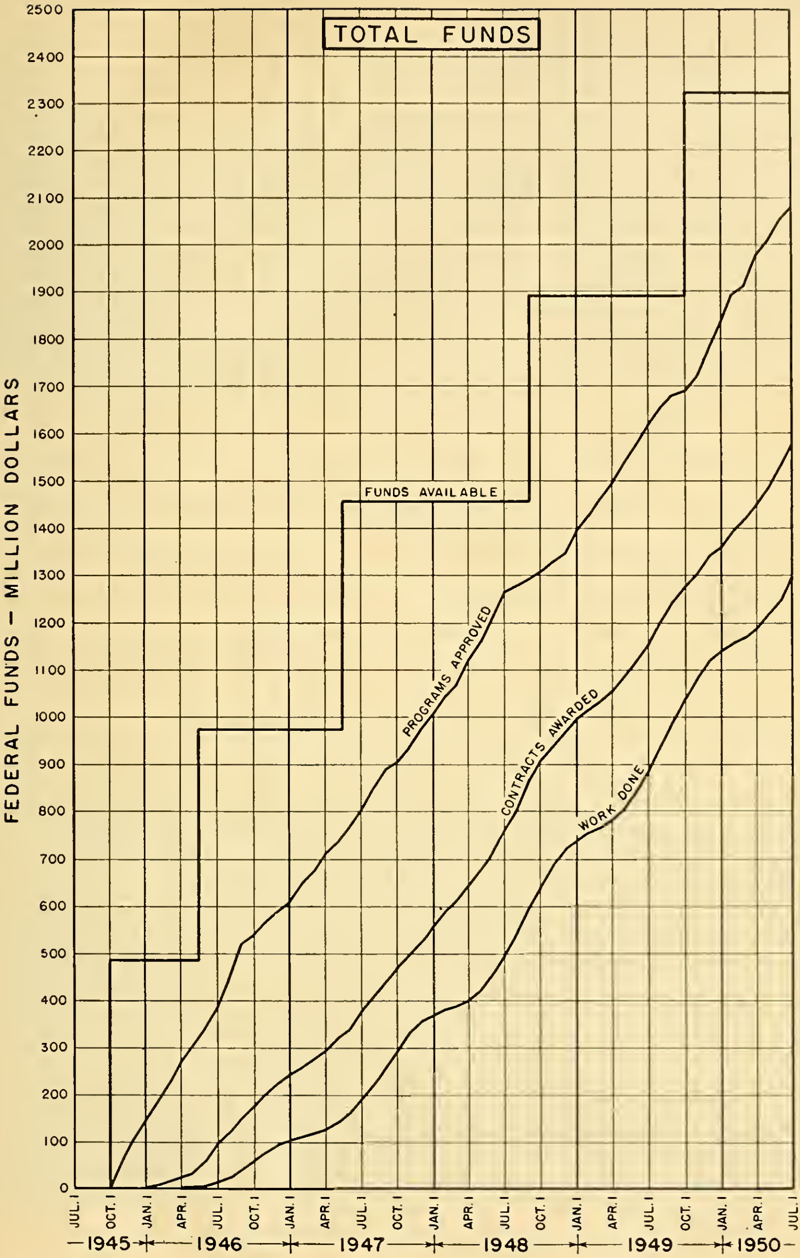


Figure 3.—Progress in approving programs, awarding contracts, and constructing projects with postwar Federal-aid funds; summary.

During the fiscal year the planning of Federal-aid urban highway systems in cooperation with State and city officials was completed for 116 cities and considerable progress was made on system planning in other cities. The arterial routes that comprise a system are major elements in any plan of city development. Fixing of their locations can be done intelligently only in conjunction with general planning for the city as a whole.

Many cities had effective planning commissions, supported by city funds and sometimes by State funds, that were the logical group to represent the city. They were already engaged in the assembly of factual data on city conditions and were familiar with traffic problems and did excellent work in planning systems. Where it has been necessary to create an organization to make the special studies that must precede intelligent highway planning, the Federal authorization of the use of 1½ percent of the funds apportioned to a State for research and planning has made possible studies that otherwise might not have been made.

Urban highway funds are available for expenditure in cities with population of 5,000 or more. Improvements need not necessarily stop at municipal limits but must be within an "urban area" defined for the purpose of Federal-aid highway improvement. Nearly all the 2,000 cities having a population of 5,000 or more have been incorporated in about 1,600 urban areas approved in accordance with the Federal legislation. In the past fiscal year, the limits of 78 of these urban areas were revised to meet changing conditions, particularly in the suburban communities. In some cities suburban communities were included within the corporate limits and thereby became a part of the designated urban area. In others they were added to the urban area because of their urban characteristics, even though not included within the corporate limits.

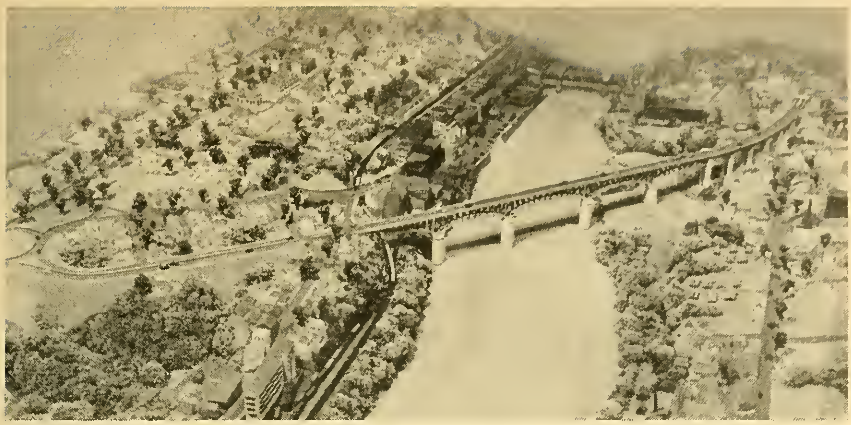
The preparation of city plans, designation of systems of urban arterial highways, and later the preparation of construction plans, require a high degree of skill, considerable experience in urban transportation problems, and much work by a staff of specialists. With the general increase in improvement of all classes of highways the States found themselves undermanned for the urban work and many of them found it necessary to employ consulting engineers. Since the inception of the urban highway program, Federal aid has been requested to pay a portion of the cost of consulting engineering services on urban highways.

Work on Outstanding Projects

The year was notable for the number of cities, urgently in need of express highways, which advanced projects from the planning stage and made substantial progress on construction. Most often the improvement begun was a first section of an undertaking so large that it must necessarily extend over a period of years.

New bridge at Augusta, Maine, takes traffic off business streets.—The urban area of Augusta, Maine, lies astride the Kennebec River. A large amount of local travel converged toward the old bridge across the river, and it was also used by through travel to and from northern Maine. Passing through Augusta on a busy day, traversing narrow streets and steep grades was an interesting but time-consuming experience. The accompanying picture shows a model of the new high-level bridge and approaches placed in use during the year. The model also shows the old bridge with business streets at each end.

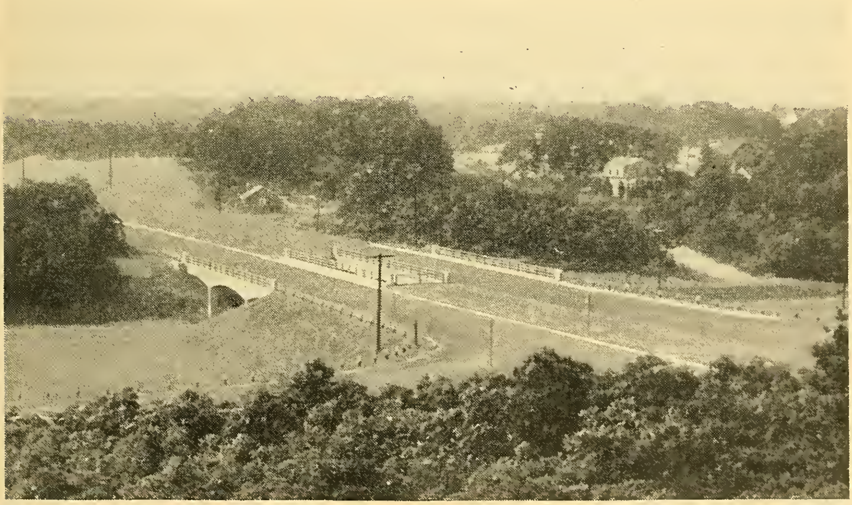
Relief for Plymouth, Mass.—The main route from Boston to Cape Cod, in Massachusetts, passes through the village of Plymouth where it has long been choked with traffic, especially on summer weekends. Much-needed relief has been provided by the construction of a 7.6-mile controlled-access highway built



Model of high-level bridge and approaches at Augusta, Maine.

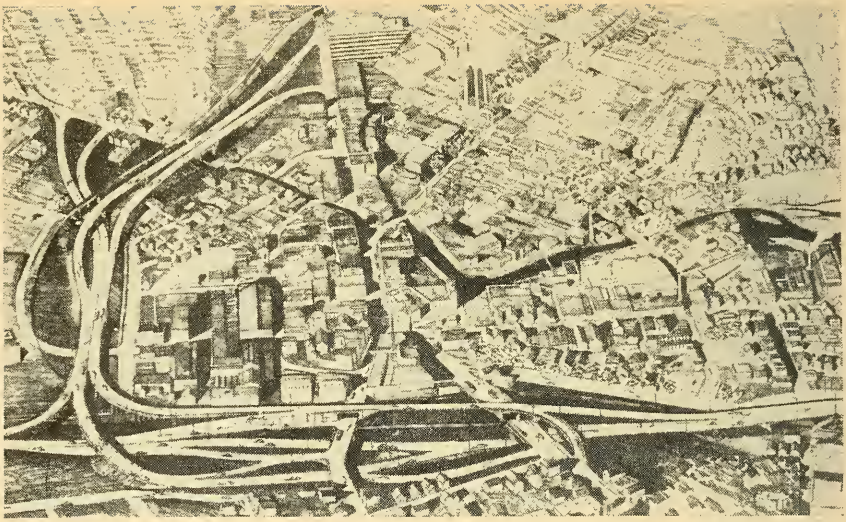
entirely on new location. It is estimated that this alternate route around Plymouth will take about 3,000 cars daily out of the congested area of the city and speed them safely on their way to and from Cape Cod.

Only one roadway was constructed except for short sections of divided highway at the most important intersections. Provision was made for construction of a second roadway when a full-length four-lane divided highway is warranted by traffic. Included in the present improvement are 10 highway grade separations at the most important intersections.



An alternate route that avoids congestion in Plymouth, Mass.

Olneyville Expressway at Providence, R. I.—Providence, R. I., with State and Federal assistance, took its first major step in modern expressway improvement by beginning construction of the Olneyville Expressway to relieve Olneyville Square, which has been a continuing and increasing source of costly traffic congestion since automobiles became numerous.



Sketch of the expressway being constructed in Providence, R. I.

The expressway passes 1 mile west of downtown Providence, on the direct route to Hartford, and serves but does not enter the busy shopping district for which it is named. Sixty percent of the traffic in the central square will be removed and distributed among the nine major radial streets which feed into the area. This bold enterprise necessitates construction of 10 bridges, including a 2,000-foot viaduct over railroad tracks, and approximately 1¼ miles of expressway.

New Jersey opens important expressway.—Completion of 6 miles of unusually expensive construction in New Jersey permitted traffic from midtown New York City, coming through the Lincoln Tunnel, to continue westward to a direct connection with U S 46.

Access to the highway is partially controlled by elevating or depressing the route. Highway grade separations were built at 12 intersecting streets, and other streets were closed to prevent cross traffic. Two railroad overpasses, two stream bridges, a 700-foot bascule lift bridge over the Passaic River, and two parallel streets were built as part of the route. Separation of the opposing traffic streams was obtained by a continuous center island which allows only right turns onto the exit ramps.

Although the cost was high, over $10 million for construction alone, it is estimated that the 13,000 vehicles which already use the route daily will save over a half-million hours in driving time yearly.

Congestion removed on approach to National Capital.—The piling up of traffic that occurred regularly on the main approach to Washington from the south has been eliminated with the completion of a new bridge, paralleling the existing 14th Street bridge, to serve north-bound traffic. The old bridge will continue to serve south-bound traffic until a companion structure to the new bridge can be built at some future time. After completion of the new bridge the average weekday traffic over the two bridges rose to 80,000 vehicles daily. A further increase was expected after resurfacing of the old bridge.

Modernization of U S 21 in West Virginia.—U S 21 between Charleston and Parkersburg is one of the most important north-south routes in West Virginia.

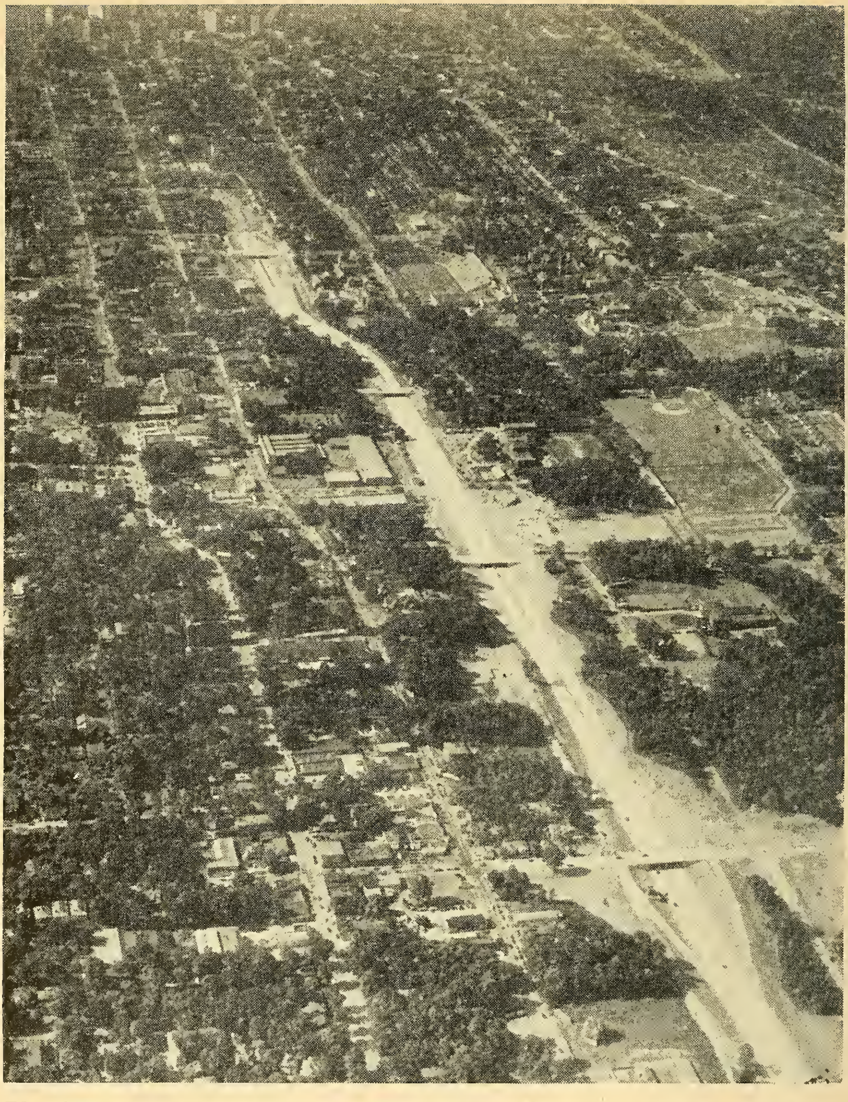
Large volumes of earth had to be moved in modernizing U S 21 in West Virginia.

The original improvement, a 16-foot pavement constructed in the early 1920's on a winding location, had become completely inadequate. Improvement had been made in the vicinity of Charleston, Ripley, and Parkersburg but a 20-mile section remained as a dangerous bottleneck. The greater portion of the section is to be relocated and improved with a 24-foot pavement and 10-foot shoulders. Work was begun on 5 miles during the year. The accompanying illustration shows the extensive grading necessary in modernizing the highway.

Washington-Baltimore Parkway.—The need for a modern highway with controlled access between Washington and Baltimore has been talked of for a number of years. Events of the year bring such a highway much closer to reality. For 10½ miles from the Baltimore city limits construction is to be as a Maryland Federal-aid project and for the remainder of the distance to Washington as a National parkway.

A four-lane, divided highway on new location with controlled access for the entire distance of about 30 miles is planned. There will be no cross traffic at any point and the new route will be shorter than the old one by about 4 miles. Provision is made for an additional lane in each direction when needed. Maryland made good progress on the portion it is to construct. Shortly after the end of the fiscal year Federal funds were authorized for the portion to be built as a National parkway and plans were ready for beginning work at an early date.

Atlanta Expressway.—Atlanta has lost no time in carrying out a metropolitan highway plan developed with the assistance of the Georgia State Highway Department and the Bureau of Public Roads. At the end of the fiscal year the first section of the expressway from the central business district toward the north was nearing completion. Construction was started on extension of the expressway south to the west side of the business district and north to connect with Peachtree Street where 30,000 vehicles per day will be intercepted. Other segments of the metropolitan plan were either under construction or nearing that stage.



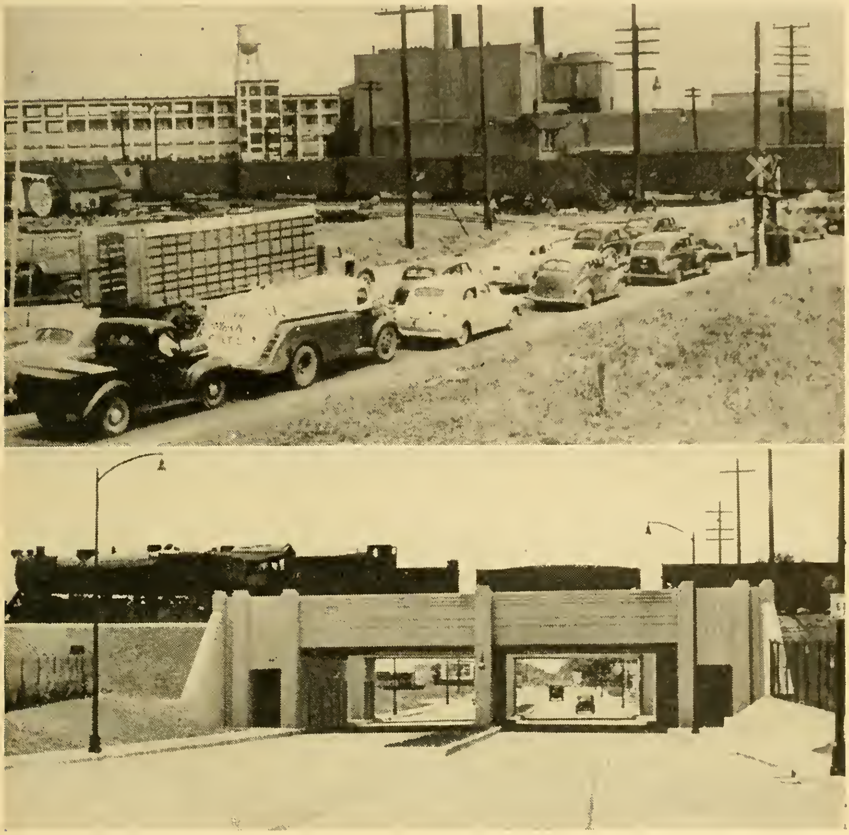
The first section of the six-lane Atlanta Expressway as it neared completion.

Alabama contributes conspicuous example of highway modernization.—A notoriously tortuous deficiency in the interstate system in Alabama on U S 31, beginning 30 miles south of Montgomery and ending 4 miles southeast of Greenville, was eliminated by reconstruction on a new direct alinement. The relocation is 18.3 miles in length, or approximately 6 miles shorter than the old road, which will continue to serve local traffic.

On the old road there are 70 curves, including 23 S-curves. Twelve miles of the old route are zoned for no passing and during 1948 11 accidents were reported on this 12 miles of road and a total of 16 accidents were reported on the entire section being replaced. The high accident record was due to hazards resulting from poor alinement, limited sight distance, and inadequate 18-foot pavement.

The new improvement has a wide graded roadway, a 26-foot bituminous pavement, 6-foot bituminous surface-treated shoulders, easy grades, and unrestricted sight distance.

Intolerable traffic blockade eliminated in Indianapolis.—Kentucky Avenue in Indianapolis was traveled every day by 15,000 vehicles which had to cross railroad tracks used for 130 train movements. The result is shown in an accompanying illustration. The companion picture shows the complete removal of all obstruction effected by a new grade-separation structure.



Traffic delay on Kentucky Avenue in Indianapolis at a railroad grade crossing, and the free-flowing condition that exists since the grade-separation structure was built.

Modernization of U S 12 approaching Milwaukee.—On the 8 miles of U S 12 nearest Milwaukee traffic averaged about 10,000 vehicles per day and was twice that during the summer peak. The old road built in 1926 was 28 feet wide—entirely adequate for two-lane traffic, but just wide enough to induce some drivers to attempt reckless passing. In 4½ years, 267 accidents occurred, 7 of them causing deaths. Since 1948 contracts have been awarded for 2 bridges and 8 miles of grading to extend a divided roadway within 1 mile of the central business district of Milwaukee.

First controlled-access highway in Arkansas.—Work on the first highway in Arkansas with controlled access was begun. Eight miles of improvement beginning at a west approach to the new Mississippi River bridge will form part of interstate system routes from Memphis to Little Rock and to St. Louis. The improvement is on a 250-foot wide right-of-way. In the initial improvement a two-lane concrete surface is being provided for through traffic, and later two additional lanes and a 30-foot median strip will be constructed. Frontage roads to serve abutting property are being constructed. Entrances to through lanes will be provided only at about one-half mile intervals. Rail and highway grade-separation structures were to be contracted for soon after the end of the year.

Expressways in Texas.—Texas continued to maintain its outstanding position in the development of urban expressways. All Federal-aid urban highway funds have been allocated to expressway projects in the four major cities—Houston, Dallas, San Antonio, and Fort Worth. Houston has completed 4.3 miles of freeway and 1 mile of what is called a "four-street system". The results reported by the State for 20 months of operation are striking. Traffic has grown from 28,800 vehicles per day to 63,300. There have been only three traffic fatalities in 90 million miles of vehicle travel. Time saved by drivers amounts to nearly 3 million hours. Money saving is estimated at $4.7 million, or more than enough to pay for 2 miles of expressway exclusive of right-of-way.

Santa Ana Freeway in California.—The Hollywood and Santa Ana Freeways on U S 101 and an alternate route of U S 101, on the interstate system, are being constructed to provide a continuous route for unobstructed travel through the Los Angeles metropolitan area from North Hollywood to a point beyond Santa Ana, a distance of 44 miles. Construction is progressing, as funds permit, at places where traffic conditions are worst. The freeway is designed to have three traffic lanes in each direction, separated by a raised strip. Crossings with railroads and other highways are to have grade separations. There is to be no access from abutting property, and outer highways or frontage roads are being constructed as necessary. During the year, work was begun on a section nearly 1 mile in length where the worst traffic jams have occurred. The work includes structures to carry three railroad tracks and two highways over the expressway.

The Federal-Aid Highway System

Improvement of the Federal-aid highway system continued to be the largest single activity of the Bureau. Many of the major improvements were located on the National System of Interstate Highways which represents about one-sixth of the system. The Federal-aid highway system as now designated includes 219,776 miles of primary highways outside of urban areas and 14,710 miles in urban areas.

Improvements on rural highways where the average daily traffic is over 5,000 vehicles are usually of the four-lane type. Such improvements represent about 5 percent of the mileage completed on the primary system during the fiscal year.

There has been a marked advance in the standards for both two-lane and multilane highways. Large quantities of earth are moved in widening, straightening, and easing the grades on older roads. Embankments are constructed with gentle slopes to prevent erosion and for safety. Widths of traffic lanes were 8 or 9 feet in early road improvement. Later they were increased to 10 and 11 feet and now 12-foot lanes represent the best practice. Narrow shoulders are no longer acceptable on Federal-aid projects. On divided highways a wide median strip is being built. Standards relating to such features developed in cooperation with the American Association of State Highway Officials are being generally applied, not only on Federal-aid projects but on improvements made without Federal funds.

Joint Planning of Location of Highways and Airports

Excellent progress was made in carrying out the provisions of section 11 of the Federal-aid Highway Act of 1944 relative to highway access to airports. Under the terms of this act, Federal funds may be used for the reconstruction or relocation of highways on the Federal-aid systems which give access to airports, provided the Bureau of Public Roads and the State highway departments have concurred with officials in charge of the airport that the proposed airport and highway improvements are in the public interest. A lesser number of requests for concurrence were received during the fiscal year than previously. However, a large proportion of those received were for airports serving the larger cities.

Under the impact of the Federal-aid airport program many major cities were engaged in expanding airports or seeking new locations to furnish better air carrier service. Requests for concurrence in plans for airport development were often received at a time when extensive urban highway developments were being planned. Joint planning of a high order by representatives of the Bureau, State highway officials, the Civil Aeronautics Administration, State aeronautic commissions, cities, and officials responsible for airport improvements has many times resulted in the satisfactory solution of problems of related highway and airway transportation facilities.

In furtherance of the policy of the Bureau to coordinate highway development with that of other forms of transportation, the Bureau and the Civil Aeronautics Administration agreed to undertake joint studies to ascertain the adequacy of existing highway facilities between the business districts of major cities and the public airports serving them, and to determine the measures that should be taken to accelerate the movement of vehicular traffic between those termini when the studies indicate that existing facilities are inadequate. As a step toward the development of the most desirable techniques for use in these studies, two or three cities within each Bureau field division were selected for initial consideration.

Secondary or Farm-to-Market Roads

In the Federal-aid program for construction of secondary or farm-to-market roads, the physical accomplishment exceeded that of any previous year.

Roads to be eligible for improvement with Federal-aid secondary funds must lie on an approved system which is carefully selected in each State and county to provide the maximum community service possible within the practical limitations of foreseeable revenue for construction and maintenance. The extent of the system is not arbitrarily limited by the Federal Government so the process of selection and approval is a continuing one from year to year. During the fiscal year about 7,000 miles were added to the system, bringing the total for the 48 States, the District of Columbia, Hawaii, and Puerto Rico to over 400,000 miles. For the 48 States alone the total is some 1,500 miles less.

More than 13,000 miles of secondary road improvements were completed during the fiscal year—slightly more than in the preceding year. This compares with a total of 16,300 miles completed in fiscal years 1946, 1947, and 1948 combined. At the end of the fiscal year 88 percent of the $696,750,000 of Federal-aid secondary funds apportioned to the States in the postwar program had been committed to approved programs initiated by the States and counties.

Since initiation of a major program of improvement of secondary roads at the end of the war there have been programed for improvement 68,300 miles of which 50,700 miles had been completed or were under construction. The remaining mileage was in various stages preparatory to actual construction.

Traffic volume on the roads improved is evidence of their feeder-route characteristics. Of the more than 13,000 miles improved during the year, 11 percent carried less than 50 vehicles per day, 24 percent carried between 50 and 100 vehicles per day, 55 percent between 100 and 400, 7 percent between 400 and 1,000, 2 percent between 1,000 and 2,000, and 1 percent carried over 2,000 vehicles per day. Ninety percent of the mileage improved carried less than 400 vehicles per day.

The costs per mile of the improvements compare favorably with those obtained by counties on their own construction without Federal assistance. In an inventory of local road administration conducted during the fiscal year, typical average construction costs per mile were obtained for each county in the United States. It was found that the average Federal-aid costs for the several surface types on secondary roads fall within the predominant cost ranges of all construction by local highway agencies in the United States.

The inventory was made for the Commissioner of Public Roads by the Board of County Consultants, which is composed of 10 county engineers or other county officials—one from the area included in each operating division of the Bureau. The board was established in 1946 to obtain the advice and counsel of outstanding county officials in launching the Federal-aid secondary program. The county viewpoint obtained was so valuable that the board has been continued. During the fiscal year the board made an inventory of local highway administration covering every county in the United States. Much of the information obtained was used in the report of the Bureau to the Subcommittee on Roads of the Senate Committee on Public Works for use in considering the regular Federal-aid highway legislation. Some of the more important findings of the report are presented on page 40.

Typical Farm-to-Market Road Improvements

Improvement of a secondary road or bridge arouses great interest only among those who must use it to reach their church, school, or market. To these people road improvement means removal of difficulties in all travel away from their farms and in many cases the end of almost complete isolation during a portion of the year. In the aggregate the conversion of farm-to-market roads to year-round service is greatly increasing the food supply of the Nation and improving social life on the farm to an extent that benefits and strengthens the entire country.

The following descriptions of improvements made are typical of thousands of projects in all parts of the United States.

In northern Georgia a road has been built between Dahlonega and Cleveland and surfaced with tailings from an old gold mine. The new road through fertile mountain valleys replaces an old winding mountain trail. The area is already showing improvement in farms and residences. Travel distance between termini is reduced by 8 miles.

Florida has many areas of soil rich in humus that are capable of growing winter vegetables and other products at an amazing rate, but which have been little used because of the difficulty in reaching markets. The accompanying illustration shows a trail through a dense tropical growth. Frequently parts of the trail were under water for extended periods and in dry weather the loose sand was difficult to get through. Passing other vehicles was a problem in any kind of weather. The companion view shows the new road that has been built.

A secondary road in northern Georgia. Notice the old winding road now replaced.

Since several serious accidents have occurred at the grade crossing, a flashing signal was installed. The area served by this particular road produces potatoes, tobacco, hogs, and watermelons.

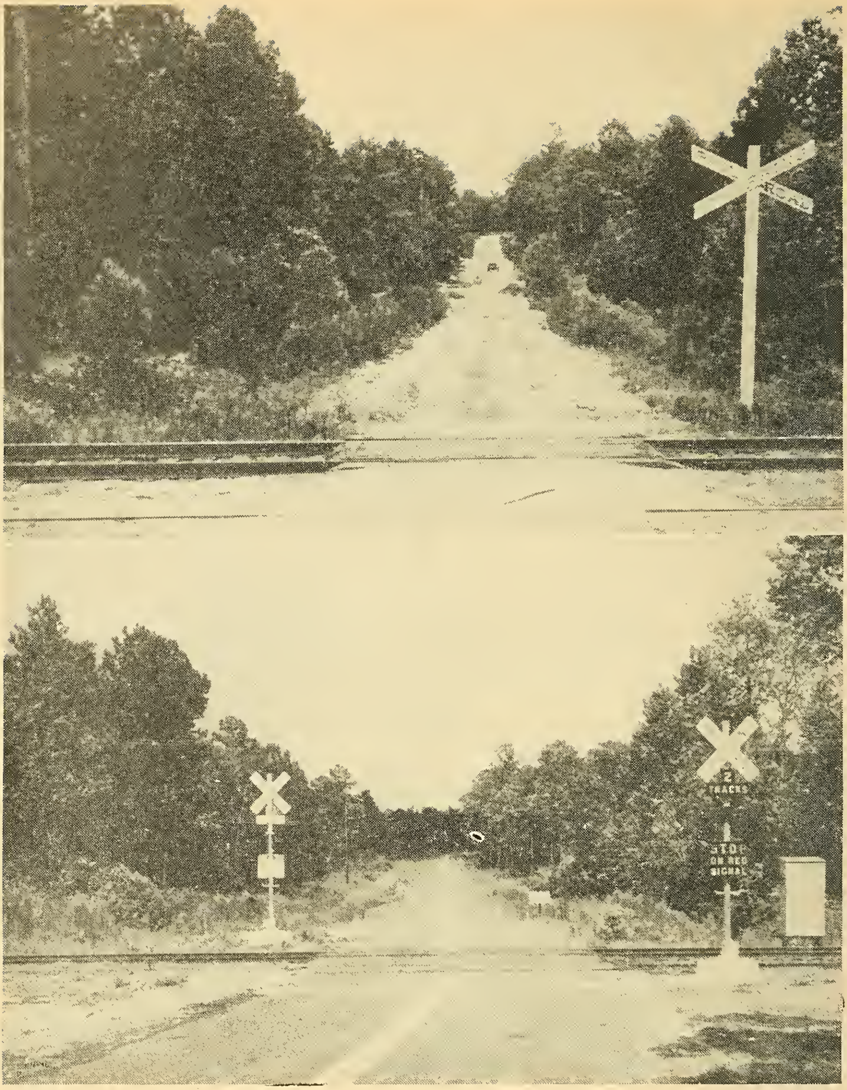
In Edgar County, Ill., two small communities surrounded by productive farm land needed an all-weather outlet to a main highway. The existing road crossed a low area where water ponded to a depth of 2 or 3 feet during rainy seasons. In the improvement of the road it was necessary to construct an 18-inch storm sewer for a distance of more than one-fourth mile. This was an expensive but necessary item.

The most common characteristic of secondary roads in every State is old obsolete bridges likely to fall under any moderately heavy load. Each year many bridges fail or are washed away by an unusual flood. When this happens the people served by the bridge must wait many months for replacement, and in the meantime travel poor and circuitous routes to sell their products and buy what they need. Federal-aid secondary road funds are being used to replace old bridges and forestall disaster. An accompanying illustration shows a one-lane bridge in Wisconsin, built 50 years ago, that was due to fail before very long if left in use. It was replaced with a 200-foot span of ample two-lane width.

Newton County, Ark., had neither a railroad nor paved highway as an outlet for its lumber, dairy, and farm products. A bituminous road, 11.6 miles in length, was nearing completion at the end of the year, to serve the county and also to provide an entrance to the Ozark National Forest. It will permit tourists to enter the scenic mountainous area adjacent to beautiful Buffalo River.

Texas has been one of the consistent leaders in improvement of secondary roads. Rich black soil produces large crops but is extremely sticky and difficult to travel when wet. In some areas it has been necessary to hitch four mules to a wagon to get produce to market. An illustration shows one of the numerous roads completed last year.

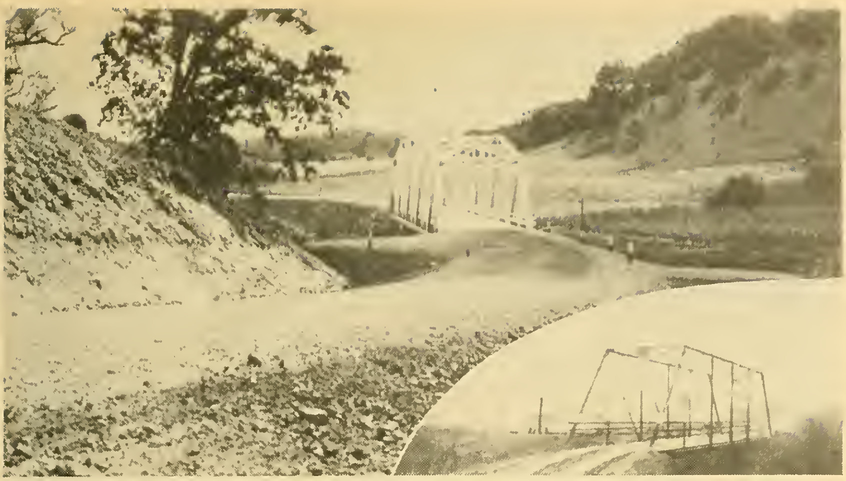
Many of the secondary roads in the Western States serve farming and grazing interests and also give important service in the production and transportation of raw materials of particular importance in the national economy. The Helena-Wilborn road in Montana is such a road. Logs are cut and sawed on the western



Before and after road improvement in the Everglades section of Florida.

slope of the Rocky Mountains and the lumber hauled over the summit on the road to a rail loading point where it is shipped mainly to eastern markets. Over 300 tons of high-grade zinc and lead concentrates are also hauled each month over this road.

Many of the farm-to-market roads in California are heavy-traffic roads and require a high type of construction. The Santa Clara Valley annually produces several hundred thousand tons of fruit that will be spoiled if hauled over rough roads. During the past fiscal year Federal-aid funds for secondary roads were used to convert a 2½-mile section of a rough road to wide smooth surface at a cost of $76,000. The road carries a daily traffic of 2,000 to 3,000 vehicles, including about 500 trucks.



A 50-year-old bridge in Wisconsin that reached the end of its useful life, and the modern structure that replaces it. Relocation of the stream crossing was necessary.

Texas is rapidly extending its wide network of excellent farm-to-market roads.

Highway Improvement Under Direct Supervision of the Bureau

In addition to administration of the Federal-aid highway work for which the contracts are let and all direct engineering work performed by the State highway departments, the Bureau is responsible for direct supervision of a considerable volume of highway work. Part of this work is financed with funds made available to the Bureau by congressional action. The remainder is work performed for other Government agencies under inter-bureau agreements, with funds appropriated to those agencies.

Hauling lumber over a secondary road in Montana.

On this class of work the Bureau makes surveys, prepares plans, and supervises construction with its own employees. The expenditures made during the fiscal year on such work are given below.

Forest highways	[2] $27, 496, 800
Park roads, trails, and approach roads	[3] 899, 900
Parkways	[3] 4, 912, 200
Forest development roads	554, 500
Cooperative work, forest highways (contributions for local work)	619, 100
Virgin Islands (Bureau of Community Facilities)	226, 800
Los Alamos roads (Atomic Energy Commission)	67, 900
Emergency reconstruction and repairs (Forest Service)	667, 800
Timber access roads (National Housing Agency)	247, 800
Public lands highways	777, 500
Roads, bridges, and trails, Alaska:	
Turnagain Arm	3, 883, 100
Surveys	624, 500
Construction in interior Alaska for Alaska Road commission	[4] 6, 111, 900
Total	47, 089, 600

Forest highways

Forest highway construction gained momentum during the past two fiscal years and was proceeding at a fairly rapid rate at the end of the year. However, the rate of progress, as governed by available funds, was much below that necessary to provide an adequate system within a reasonable period of years. The status of forest highway construction at the end of the year is shown in table 16 of the appendix. Construction accomplishments during the fiscal year are indicated by expenditure during the year of $27,496,800, exclusive of funds provided by States and local authorities. Five hundred and forty-one miles were completed and at the end of the year 811 miles were under construction or ready for construction. Typical forest highway improvements are described in the following paragraphs.

---

[2] Does not include expenditures from cooperative funds provided by States or local agencies.

[3] Includes expenditures by National Park Service.

[4] Estimated value of payments made by Alaska Road Commission.

Snake River Bridge.—Construction of a 310-foot steel arch bridge across Snake River in Teton National Forest in Wyoming and an adjacent section of highway was begun. This length of span places the bridge among the notable forest highway structures. Completion of the bridge and 26 miles of forest highway forming part of U S 89 will open a new route saving from 50 to 135 miles in traveling from Utah and southeastern Idaho to Jackson Hole, Grand Teton National Park, and Yellowstone National Park. It will be possible to make a gradual climb to Jackson, Wyo., at an elevation of 6,235 feet instead of going over a summit on the Teton Pass route at an elevation of 8,430 feet. The difference in elevation of over 2,000 feet makes a great difference in travel conditions from early fall to late spring in this area.

Blue Creek Bay Bridge.—Work was started on a bridge across Blue Creek Bay on Lake Coeur d'Alene in Idaho. This project is notable both because of difficulties overcome in design and construction and the service to travel that will be given by the bridge. Pipe caissons to support the bridge must pass through 80 feet of water and 250 feet of soft clay and sand before reaching solid rock. There are few structures in the world so located that it has been necessary to penetrate to a depth of 330 feet to find firm support. This bridge will form a link in the interstate highway system and U S 10, which is the principal route across the Idaho Panhandle for transcontinental and interstate travel between points in Montana, Idaho, and Washington. It will effect a saving of 2 miles in distance and eliminate a climb to a point 700 feet higher over a narrow, winding, and dangerous road.

Swift River Forest Highway.—An important forest highway project in the East is the 4 miles of construction in the White Mountain National Forest of New Hampshire. This project is on the Swift River Highway which, when completed, will open up virgin territory and provide a new highway across the mountains, connecting Lincoln with Conway.

Forest development roads

The Forest Service of the Department of Agriculture has for years called upon the Bureau to prepare plans and supervise construction of major forest development roads. These are the roads of primary importance for the protection, administration, and utilization of the forests and their resources. At the end of the fiscal year construction of 12 forest development roads totaling 44 miles in length was being supervised.

National park highways, park approach roads, and parkways

Programs for the improvement of highways making National parks accessible to the public, and for parkways, are developed in cooperation with the National Park Service. Construction contracts are awarded by the Secretary of the Interior but the Bureau does all engineering work, including supervision of construction.

There was a marked increase in rate of progress on this work. During the year 170 miles of road were completed, and 233 miles were under construction at the end of the year. Surveys were completed or under way on 565 miles for which future construction was planned.

The mileage of roads completed or under construction within each of the National parks and monuments and on the various park approach roads and parkways is shown in tables 18 and 19 of the appendix.

The Bureau and the National Park Service cooperated in the planning of a National park highway system, including approach roads, to serve adequately the increasing numbers of tourists visiting the park areas each year. When the selection of routes is completed the two agencies will prepare a joint report on the system needs and the cost of meeting them over a period of years. Such information is needed as the basis for planning an adequate program. Examples of current park improvements follow.

Stevens Canyon Highway.—Construction of the Stevens Canyon Highway in the southeastern part of Mt. Rainier National Park in Washington was far advanced when work was stopped in 1942 because of the war. Construction remained inactive until last year and the road was unusable, although completion of only about a mile of grading and construction of a 162-foot tunnel and a number of bridges and viaducts were needed to open the road through the canyon.

Construction was begun in the fiscal year on the tunnel, two bridges and two viaducts, and 0.8 mile of grading. When the road is completed it will not only afford access to the scenic and recreational features of the park but will also provide a new east-west route for through traffic where no route now exists in a distance of 40 miles north and south.

Moran-Yellowstone Park approach road.—The Moran-Yellowstone Park approach road in Wyoming is a part of U S 89 and 287 and provides access to the south entrance of Yellowstone National Park. The southerly 5.9 miles of the route were constructed in 1931 and 1932 and the northerly 3.3 miles were completed in 1948. The intervening gap consisted of 15.3 miles of unimproved, narrow road with steep grades and sinuous alinement. Work was begun on grading and surfacing this section during the fiscal year.

Turnagain Arm and interior Alaska roads

At the request of the Department of the Interior, the Bureau undertook in 1948 the survey, design, and construction of the Turnagain Arm section of the Seward-Anchorage highway in Alaska. This section begins 58 miles north of Seward and extends 47.5 miles around Turnagain Arm Bay to Indian. There was no road between these points and the construction of this section, together with the construction of the 12-mile section from Indian to Potter by the Alaska Railroad, will make highway transportation possible all the way from Seward to Anchorage. As it will supplement or substitute for the railroad transportation now available but which may be discontinued soon, it is vitally important to the development and defense of Alaska. Contracts for work to cost $7,194,700 were awarded during the previous fiscal year for the grading and drainage structures on the Turnagain Arm section and by the end of the fiscal year the work was approximately 75 percent complete.

In accordance with an inter-bureau agreement the Bureau also undertook for the Alaska Road Commission an extensive program of road improvements in interior Alaska. The work undertaken includes survey and preparation of plans on 613 miles and supervision of several contracts for reconstruction and bituminous surfacing on 212 miles of the Glenn, Richardson, and Alaska Highways. This entire construction program was placed under contract during the previous fiscal year at a cost of $8,659,887 for the 212 miles. At the end of the past fiscal year construction on the Glenn and Alaska Highways and on one section of the

Richardson Highway was practically completed and it was expected that the remainder would be completed before the end of the 1950 working season.

Public lands highways

Prior to World War II, funds were authorized at various times for improvement of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, or other Federal reservations other than National forest reservations. Although no additional funds were authorized after the war (until enactment of the Federal-aid Highway Act of 1950), some work has been done with remaining balances of prewar authorizations.

At the end of the fiscal year all but a negligible amount of the total authorization since 1931 of $26,000,000 had been programed to projects, $25,106,565 worth of work had been completed, and $482,828 worth was under construction.

Special projects for other agencies

Virgin Islands roads.—At the request of the Bureau of Community Facilities, formerly a part of the Federal Works Agency, highway construction to cost approximately $653,000 was undertaken in the Virgin Islands. The work was nearly completed at the end of the fiscal year.

Los Alamos roads.—Construction of 4.9 miles of highways at Los Alamos, N. Mex., at an estimated total cost of $435,000, was undertaken for the Atomic Energy Commission. The work was completed early in the fiscal year.

Timber access roads.—A large program of road construction was supervised for the National Housing Agency to provide access to timber urgently needed to expedite construction of housing for veterans. The total program cost approximately $6,572,000. The last of the construction was completed during the fiscal year.

Emergency reconstruction of forest-development roads.—The Forest Service requested the Bureau to assist in reconstruction and repair of forest-development roads heavily damaged by severe floods in the Pacific Northwest States in 1949. A total program of work to cost approximately $1,143,000 was undertaken and was in progress at the end of the fiscal year.

Cooperative work for counties.—Occasionally, when a forest highway project is under construction, the county or some other local government agency desires to take advantage of the presence of construction crews on the project to get some other road in the locality constructed. The local agency enters into an agreement with the Bureau to have the work done in conjunction with the construction of the forest highway. Payment is made from local funds deposited with the Bureau. Work of this type costing $619,000 was done during the fiscal year.

Indian roads.—A total of $30 million has been provided in the postwar period (exclusive of authorizations provided by the Federal-aid Highway Act of 1950) for roads giving access to Indian reservations and Indian lands. The Bureau of Indian Affairs of the Department of the Interior selects projects and supervises construction. The Bureau of Public Roads acted in an advisory capacity on the work done during the year.

Repair of War-Damaged Highways

The repair of war-damaged roads as authorized by the Defense Highway Act of 1941 was continued in cooperation with local officials.

At the close of the fiscal year 287 claims for the repair of 6,085 miles of roads, in the amount of $10,418,192, had been received and recommended for payment.

Funds have been appropriated for payment of 257 of these claims for 5,778 miles of road, in the amount of $9,410,555. During the fiscal year 16 claims for the repair of 211 miles of road, in the amount of $428,803, were paid. Ten claims were pending on June 30, 1950. When these are disposed of, this activity will be terminated.

The rehabilitation of 7,815 miles of roads in military maneuver areas in Tennessee, Louisiana, Texas, and Mississippi, authorized by Public Law No. 288, Seventy-eighth Congress, has been completed at a cost of $3,969,145.

Repair of Flood-Damaged Roads

For many years the Federal Government has aided the States in the repair or reconstruction of highways and bridges damaged or destroyed by floods and other disasters of extraordinary character and extent. Such aid has been possible under authorizations permitting the use of available emergency relief funds without waiting for specific legislative action following each disaster. Aid is now limited to routes on the Federal-aid highway systems.

Allocations of emergency relief funds totaling $3,299,526 were made during the fiscal year to 11 States to assist in rehabilitation work estimated to cost $7 million. Of these funds $1,170,659 were allocated for the repair of flood damage that occurred during previous fiscal years in seven States, for which additional funds were required to complete the necessary rehabilitation work. The remaining $2,128,867 were allocated to four States in which floods occurred during the fiscal year.

Arkansas, Oklahoma, Virginia, Washington, and West Virginia received the major portion of the emergency relief funds allocated for the completion of rehabilitation work necessitated by floods that occurred during previous fiscal years. Nearly half of such funds was allocated to West Virginia for repair of damage caused by the June 1949 floods and accompanying mountain slides along the watershed of the south fork of the Potomac River. Work necessitated by disasters in previous fiscal years has either been completed or is nearing completion.

Allocations totaling $2,128,867 have been made to Minnesota, North Dakota, South Dakota, and Nebraska to assist in rehabilitation work necessitated by the unprecedented spring floods of 1950.

Other floods occurred during the fiscal year in West Virginia and Wisconsin. These States have notified the Bureau of their intention to request allocations of funds to assist in highway rehabilitation work. Hawaii has notified the Bureau of its intention to request emergency relief funds to assist in repair of highways damaged or destroyed by the lava flows resulting from the June 1950 eruptions of Mauna Loa Volcano. Only a small balance of emergency relief funds remained unallocated at the end of the year.

Hawaii War and Emergency Damage Program

A Federal fund of $10 million was authorized in 1947 for rehabilitation or repair of roads and bridges in Hawaii that had been damaged by the armed services or by contractors in connection with prosecution of the war, and for the restoration or reconstruction of highways and bridges that were damaged or destroyed by seismic waves in April 1946.

On war damage work the Territory is required to match Federal funds to the extent required by the Commissioner of Public Roads. On seismic-wave-damaged work the Territory must make a contribution equal to that of the Federal Government. This authorization, for Hawaii only, is similar to previous authorizations for emergency reconstruction of highways and bridges damaged by floods or other disasters over a wide area as provided for the States by various Federal-aid highway legislative enactments.

By the end of the fiscal year programs had been approved for war-damaged roads costing $3,485,922 in Federal funds and for seismic-wave-damaged roads costing $6,064,380 in Federal funds. The total cost of the work, including matching funds, was $15,931,563, providing for the rehabilitation or repair of 272 miles of roadway and bridges.

Rehabilitation of Philippine Highways

Under the Philippine Rehabilitation Act of 1946 the Bureau of Public Roads was authorized to design, restore, and rebuild, in cooperation with the Philippine Government, roads and bridges that had been war-damaged or that would aid in the economic recovery of the Philippines.

The Philippine Government is represented in this work by its Department of Public Works. The total cost of the program will be approximately $50 million of which the United States will contribute $40 million, including necessary administrative expenses. The program at present consists of 305 construction projects, 5 highway planning survey projects, and a Nation-wide bridge project for the purchase of highway and bridge building equipment and material covering 226 minor bridges being constructed by Philippine Government forces. Participation by the United States in the Nation-wide bridge project is limited to the furnishing of reinforcing steel and concrete mixers and technical assistance. The construction projects provide for the rehabilitation of 364 miles of highway including 263 major bridges.

The program progressed satisfactorily during the fiscal year. The objective set for the year was carried out in that all projects were designed, advertised, bids opened, and funds obligated by the end of the year.

Congress amended the Rehabilitation Act of 1946 to extend the final date of completion of the program from June 30, 1950, to June 30, 1951. During the fiscal year 98 projects were completed and work was started on 128 more. Since the beginning of the program 132 projects have been completed, and 102 are under construction. It was anticipated that contractors would be ordered to commence work on all remaining 77 projects by July 31, 1950, and barring any unforeseen contingency would have all work completed by June 30, 1951.

One of the most extensive projects under way during the year was the paving of 106 miles of streets in Manila. In addition to city streets, two major bridges were completed and contracts let for two more major bridges across the Pasig River in Manila. The latter are the Santa Cruz Bridge and the Ayala Bridge. The four bridges will cost approximately $2.5 million. To provide an adequate approach to the Ayala Bridge it was necessary to plan a new four-lane divided street through a heavily built-up district. The Philippine Government has purchased right-of-way and is clearing buildings from the location at a cost of over $500,000.

Major street improvement in Cebu, second largest city in the Philippines, is well under way. Twelve miles of central business streets are being improved at a cost of $874,000.

Progress on the 226 smaller bridges for which the Bureau is furnishing reinforcing steel has been fair, with some provinces having completed all of the bridges within their jurisdiction.

The highway planning survey organization of the Philippine Department of Public Works has compiled a complete statistical report covering the present condition of Philippine highways, their traffic, needed improvements, and finances. This is the culmination of the 3-year effort to provide factual data for long-range planning, so necessary to every successful highway organization. This work, originally supervised by Bureau personnel, progressed so well that it was turned over to Philippine supervision with only occasional assistance from Public Roads engineers. The Philippine organization is now self-sufficient and is doing a good job.

A like condition prevails in the physical research laboratory established to test road materials and to train Philippine personnel in research methods. This laboratory was established and equipped under direction of Bureau personnel but is now being operated by Filipino engineers with very little technical assistance from Public Roads. Additional equipment was purchased during the year to complete the laboratory facilities, making at the only fully equipped road materials testing laboratory in the Far East.

The trainee program continued both in the States and in the field. All of the first group of ten sent to the United States for training have returned to the islands, and the eight men from the Highway Division of the Philippine Government have been placed in responsible positions where they can utilize the training they received. For example, the highway planning survey and the materials laboratory are both headed by men from the group. Others are being used as office engineers, design engineers, and district engineers. Training in the field consisted of on-the-job training given to Philippine inspectors, laboratory workers, etc., by the supervisory personnel of the Bureau of Public Roads.

Motor-vehicle registrations continued to increase in the Philippines, as well as miles traveled, so that traffic counts were correspondingly higher throughout the year. In Manila, where approximately 75 percent of all vehicles in the islands are concentrated, traffic on many streets is running over 45,000 vehicles per day, with two major arteries carrying over 55,000 and one central plaza serving over 72,000. Since traffic in the Philippines is largely commercial, the improvement and reconstruction of highway facilities greatly aid the rehabilitation of Philippine economy.

Aid to Turkey in Highway Improvement

In 1947, at the request of the Turkish Government, the Bureau of Public Roads established a division offce in Turkey to aid that country in the preparation of a program of highway improvement, to advise in the staffing of a highway organization, and to assist in the training of personnel at all levels in the administration, construction, and maintenance of a national highway system. These activities were continued during the year.

Initial authorization and aid for the carrying out of this highway program and for the procurement of equipment was made possible by the allocation of $5 million of the funds authorized for assistance to Greece and Turkey by Public Law No. 75, Eightieth Congress, in response to the Turkish Government's expressed desire to benefit from the experience of the Bureau in methods developed in the United States.

In April 1949, the Bureau was requested to continue to advise and instruct Turkish personnel in the highway program, and to procure additional equipment. The Economic Cooperation Administration made a loan of $5 million to the Turkish Government for financing such assistance. In the fiscal year 1950 the loan of funds was increased in the amount of $9 million.

The quantity of road construction and maintenance equipment acquired by the Turkish Government under this program has required careful planning for the construction of repair and service shops and for the training of machine operators and mechanics. At the start of this work there were almost no skilled mechanics or operators. The extensive training courses begun at once at the Iskenderun depot produced over 600 skilled machine operators, truck drivers, mechanics, and repairmen in the first year of operation, and a total of 1,350 men have now been trained at this depot. During this initial period a division shop was completed at Ankara and construction of the other major repair shops was begun. As these shops were completed they were staffed with mechanics and repairmen trained at Iskenderun and with other trainees for on-the-job training.

At the same time, the machine operators trained at Iskenderun were put to work on highway improvement jobs. Usually, each trained operator instructed a trainee. Thus, gradually, the training of mechanics and equipment operators has been converted from class-room instruction to on-the-job training.

It has been necessary to construct and equip division and district repair shops. There are now 6 division shops in full operation and 4 more are being completed. In addition, there are 10 district shops completed and ready for the installation of equipment and staff.

In 1950, the Turkish Government established a General Directorate of Highways within the Ministry of Public Works. This directorate has much more authority and responsibility in highway improvement than did the former Department of Roads and Bridges. Collection of a fuel tax and assignment of all of the revenue for highway construction on a continuing basis are most important steps forward.

Staffing of the General Directorate of Highways presented problems because of the lack of experienced personnel. Gradually, through the close cooperation of the Bureau staff and the engineers of the Ministry of Public Works, an organization is being evolved that will be effective. The day-to-day cooperation of the Turkish and American engineers results in the quick solution of problems as they arise.

Turkish engineers made extensive studies of the physical sufficiency of the present highway transportation system. Tonnage of freight hauled by trucks, and passengers carried by trucks and busses, were determined for all routes. The origin and destination of all for-hire vehicles were determined and commodities carried were classified.

An inventory of the national highway system made possible the drafting of road maps of the 63 provinces. Turkey's first road map for tourists was issued.

New types of bridges introduced by the Bureau's bridge engineer resulted in savings in time and money on bridge construction. Reorganization of the bridge division of the Turkish Directorate of Highways and changes in its design practices will result in more efficient work.

Extensive improvements have been accomplished in Turkey, although construction work is difficult because of the generally mountainous terrain. It is now possible to travel over many of the main highways at all seasons of the year. Stone surface courses and the plowing of snow in the winter eliminated the isolation of villages and towns that previously had often existed for months at a time. Prior to 1949, it took at least one full day to travel from Ankara to Konya. In times of rain, 2 to 3 days were not unusual for the 156-mile trip. Today, because of improvements completed in 1949, the trip can be made in any weather in 4 hours. The completed road is not elaborate, but the benefits of the gravel surface have been reflected in reductions in bus and truck rates up to 75 percent. The 285-mile trip from Ankara to Istanbul can be made today in 10 hours, rather than 16. Similar time savings are possible in many other places.

In 1947, practically all highway maintenance was done by the simplest hand methods. Machinery was not used. At the end of the fiscal year there were over 4,500 miles of national highway maintained with trucks, motor graders, asphalt repair outfits, and other modern equipment. Modern methods of highway maintenance, by the use of machines designed for the work, rapidly replaced the inadequate hand methods. Maintenance forces were trained to accept and use the new equipment and methods available. These forces made important road improvements where the quantities of work did not warrant contract construction.

Several major construction jobs were begun. This work will open new routes to highway transportation and will give tremendous benefits to the over-all economy of Turkey.

The General Directorate of Highways has, with the advice of the Bureau representatives, created a new division of highway design. Heretofore, plans were prepared by construction contractors. At the end of the fiscal year 33 survey parties were in the field and 35 surveys totaling over 1,000 miles had been completed. The designs for 11 contract projects, 330 miles in total length, and for 23 betterment projects, were completed and approved by the Directorate of Highways and by the Bureau. Specifications for construction were also completed.

The central and field organization of the General Directorate is similar to that of a large State highway department. The organization is capable of doing any work necessary to improve and maintain highway transportation facilities.

Foreign Visitors

Nearly 200 highway officials and engineers from 30 foreign countries visited the headquarters of the Bureau during the year to obtain information, special training, or to attend one of the two highway engineering courses conducted during the year. The first of these courses, which started in May of 1949 and ended in early September, was described in the previous annual report.

The second course started on May 15, 1950, and will end in early September. A total of 55 delegates from 18 countries was enrolled for the 16-week course, which was divided into five parts. On arrival in Washington the visitors were given a course of lectures for 2 weeks as an introduction and orientation period. This was followed by a 3-week bus trip in which all delegates inspected highway construction and maintenance practices. At the end of the fiscal year the participants had returned to Washington and were attending lectures and making studies so arranged that each individual could select and pursue subjects of particular interest to him. Following this period the party was to break up into small groups for a 5-week field trip for detailed studies of highway practices in selected States. The course will be concluded with a 1-week period in Washington for review and formal closing of the course.

The President's Highway Safety Conference

The Bureau continued to aid in the important work of the President's Highway Safety Conference by supplying staff, technical assistance, facilities, and other help. The Commissioner of Public Roads directed the major session of the conference during the fiscal year, a meeting of the committee on conference reports which is composed in the main of official State representatives. Individually and through their organization, the Governors' Conference, the Governors of the States gave the traffic safety movement strong support during the fiscal year.

Due to the tremendous increase in highway traffic, from less than 250 billion vehicle-miles in 1945 to more than 424 billion in 1949, the highway accident problem remained critical. The conference gave special consideration to the threat that for the first time in the 4-year history of the action program for traffic safety, the annual increase in traffic deaths outside of cities may more than offset the annual decline in urban centers.

Because the action program has demonstrated its soundness in preventing accidents, the conference is placing renewed emphasis on the control of traffic on roads in rural areas. Application of the action program is also being strengthened in all traffic situations. The soundness of the program is measured by the decline in the motor-vehicle death rate from 11.3 deaths per 100 million vehicle-miles of travel in 1945, the year previous to the inception of the program, to 7.4 in 1949.

The National Committee on Uniform Traffic Laws and Ordinances, with which the Bureau has cooperated for many years, joined the President's Highway Safety Conference during the fiscal year as one of its four national committees. The others are the State and Local Officials' National Highway Safety Committee, the National Committee for Traffic Safety (composed of 85 unofficial groups), and the Federal Committee on Highway Safety.

The conference published revised editions of its technical reports on the eight aspects of the traffic safety problem, reissued the *Action Program*, and issued the 1949–50 *Inventory and Guide for Action.*

The Inter-American Highway

The Inter-American Highway is that section of the Pan American Highway which extends from Nuevo Laredo on our Mexican border to Panama City, a distance of approximately 3,200 miles.

Since 1930 the United States, through the Bureau of Public Roads, has assisted the Republics of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama in the construction of the Inter-American Highway. The section of the highway in Mexico has been financed and constructed entirely by Mexico.

The Inter-American Highway is not passable by motor vehicles over its entire length. In Mexico it is open and in excellent condition over all of the distance from the United States to Guatemala, but in northwestern Guatemala, beginning at the Mexican border, there is a gap of 25 miles which is still impassable. In northern Costa Rica there is also a gap of about 65 miles and in southern Costa Rica and western Panama there is another gap of about 150 miles, both of which are impassable.

Among those sections that are considered passable there are many which still need improving because of inadequate surfaces, sharp turns, steep grades, and narrow roadway. However, there are many miles of good modern highway. At present 61 percent of the highway is paved. Another 30 percent is passable at all times, 1 percent is passable only in dry weather, and only 8 percent is impassable at all times.

During the year Mexico opened the Inter-American Highway to the Guatemala border. All of the Mexican section is well designed and well paved except for about 170 miles near the Guatemala border. This latter portion of the highway is usable at all times as it has a good macadam surface.

On the Central American section lack of funds has reduced the rate of construction during the past year.

In Guatemala no new projects were started and construction has proceeded at a somewhat slower rate on those which were previously under way. To a considerable extent this was due to the fact that the Government of Guatemala felt it necessary to remove a large amount of equipment which was working on the Inter-American Highway for use in rehabilitating other highways which were seriously damaged by the disastrous floods in September and October. Very little damage was done to the Inter-American Highway by these floods.

In El Salvador no work except maintenance was done. The highway in El Salvador is in good condition for its entire length and the only work remaining to complete it is the paving of about 25 miles.

In Honduras no work was done except maintenance.

In Nicaragua the paving of the section from Sebaco to Matagalpa was completed and the section from Jinotepe to Rivas was approximately 40 percent complete. One bridge was included in the work completed. No new projects were started.

In Costa Rica the only work done was removal of slides and operations to protect improvements already made.

In Panama an aerial survey was made between Concepcion and the Costa Rica border and plans were made for an aerial survey of a possible relocation of the highway between Remedios and Santiago.

Projects other than the Inter-American Highway

Two engineers of the Bureau of Public Roads continued assistance to the Government of El Salvador in the construction of the Lempa River Bridge at San Marcos.

Assistance was continued to the Government of Ecuador in the construction of the Pan American Highway between Guamote and Tambo and in preparing plans and specifications for a highway between Manta and Quevado.

During the year plans were made to send an engineer to Colombia at the request of the State of Cundinamarca to assist in the planning and construction of a state system of highways.

In the autumn of 1949 the Government of Peru made a request through our Department of State for a variety of assistance in connection with the reorganization of its National Highway Department, the systematic financing of a highway program, the selection and purchase of equipment—both for maintenance and for construction—the improvement of existing repair shops, the upkeep and care of equipment, and field instruction in the operation and use of equipment in actual work on the roads. In addition, and contingent on funds becoming available, a priority program for the further extension of the highway system and new construction was contemplated.

To meet this broad request an extended preliminary study was made, following which appropriately experienced engineers from the Bureau were assigned to take up in logical order the several elements of the work contemplated.

At the end of the fiscal year, three engineers were on the ground and work had developed to a point where it appeared probable that the project of assistance would require three or four men continuously. Arrangement had been made for a head of mission to remain in Peru and give general directions to the several lines of instruction and assistance, and to cooperate with two other United States missions already operating in Peru to extend and improve agricultural production and readjust national finances.

Assistance is given Peru under a joint agreement which provides for payment of salaries and transportation to and from Peru by the Bureau and the payment of all local expenses and maintenance of the mission in Peru by that Government. The mission was actively at work at the close of the fiscal year and will probably remain in Peru for the greater part of the following year.

Highway Needs Studies

The attention of the Bureau of Public Roads and the States continues to be focused on State-wide highway needs studies, in efforts to solve the problems created by the ever-increasing usage of roads and streets by all classes of motor vehicles.

Sound highway policy and management require: (1) the establishment of road and street systems according to the function they perform, and the determination of the cost of owning and operating each system, (2) a plan for equitable distribution of costs among highway users and general taxpayers, (3) allocation of authority and financial responsibility among the several levels of government, and (4) a plan for the regulation of highway use to protect users and obtain maximum service.

The highway planning surveys, conducted by the States in cooperation with the Bureau, were undertaken primarily to determine what should be done to provide facilities that will be adequate for present and probable future traffic needs, what the financial requirements are for carrying out such a program, and how the needed funds can be raised. Since 1946 nearly half of the States have initiated some action in connection with the first two objectives. To date, 13 States have published reports on their findings, of which three—Idaho, Mississippi, and New York—were completed during the past year. At present, studies are nearing completion in Colorado, Ohio, and Pennsylvania. The last of the three planning survey objectives, that of how the needed funds are to be raised, is currently the concern of special committees appointed by the legislature or by the governor, or otherwise created, in a number of States.

Most of the committees include in their membership representatives of road-building and road-user groups, as well as public officials. The bulk of the basic information required for consideration by these various committees is already on hand in the results of the highway planning surveys. The findings of these planning surveys relating to traffic movement and vehicle operations, forecasts of future traffic growth, forecasts of revenues for highway purposes, and equitable practices with respect to highway finance and taxation, were applied extensively in these needs studies. Applications were made in determining where improvements are required at the present time and will be required in the future on the various highway systems, design standards necessary for safe and economical transport service, programs of construction priorities, and rational means of financing a program.

The value of these studies is continually being demonstrated in the several States through enactment of progressive legislation based upon the recommendations and findings in these reports.

The Bureau of Public Roads makes a major contribution to these highway needs studies by granting technical, administrative, and financial assistance to the States and to the committees on various phases of this work. Most of the activities described in the following pages under the headings of highway transport research and financial and administrative research have application in the highway planning and needs studies.

Highway Transport Research

Activity in highway transport research is conducted by the Bureau's headquarters organization and also in cooperation with the States as Federal-aid projects.

Road inventory and mapping

Of the 36 States and Puerto Rico engaged in revising their inventory records of rural roads, bridges, and roadside features, 5 States completed this work during the year. The parallel program of revising highway maps to show current conditions resulted in the complete redrafting or revision of maps for 266 counties in 30 States. In addition to the usual features covered in an inventory of highways, sight-distance conditions on main highways were studied in 7 States.

The inventory of city streets started in recent years produced data and maps for 850 cities and other incorporated places. This program is confined to areas where adequate city maps are not available.

Traffic volumes

There was a further expansion in the counting of traffic on rural roads beyond that reported in 1949. Continuous-count automatic traffic recorders were increased by 76, bringing the total number in operation up to 900. Extensive traffic surveys were made on primary roads in practically all States, and in 24 States this work was extended to include local roads. In the calendar year 1949, traffic on rural roads reached an all-time high, being 9 percent higher than in 1948.

Additional automatic traffic recorders were operated in 22 cities. It was estimated that urban automobile traffic in 1949 was 7 percent above that of the previous year.

Truck weights

The size of loads and tonnage transported by trucks is of interest in determining the transport service rendered by trucks and is of fundamental importance in regulating gross loads and axle loads to prevent damage to roads and bridges.

Truck weighings to determine trends in axle loads and gross loads, which have been made each summer beginning in 1942, were continued at 562 stations in 46 States. In addition, more extensive weighings with portable scales (loadometers) at a larger number of stations, operated in different seasons and at different hours of the day, were undertaken in a few States. Data from the expanded operations will permit a more direct computation of ton-mileage hauled by trucks in the particular States and will give a check on the ton-mileage that has been estimated from year to year, on the basis of trends, since the comprehensive prewar surveys were made.

Average weights in 1949 were found to be slightly greater than in previous years. The average load carried by all trucks and combinations was 5.11 tons in 1949, compared to 5.02 tons in 1948. Because of this heavier loading, the ton-mileage in 1949 increased 7 percent over that of 1948, while the truck vehicle-mileage increased only 5 percent.

On the other hand, the frequency of heavy axle loads was slightly less in 1949 than in 1948. For example, axle loads of 20,000 pounds or more amounted to 39 per 1,000 vehicles in 1949, compared to 44 per 1,000 in 1948. The legal limit in most States is 18,000 pounds. This is the first year since the data have been available that the frequency of heavy axle loads has not increased. Possibly the findings of previous years, which showed the frequency of heavy loads on pavements to be increasing at an alarming rate, has resulted in better enforcement of State laws.

However, the situation is still serious. It is well known that many sections of main highways have deteriorated at an alarming rate and that such deterioration generally occurs where there is more than average frequency of heavy loads. An extensive study has been initiated to obtain more comprehensive information on the subject. This work involves the expansion of the weighing operations to cover all hours of the day and all seasons of the year, a study of pavement and subgrade types and condition, and correlation of the frequency of application of heavy loads with pavement damage under varying circumstances of subgrade and pavement design.

City surveys

With the continuing increase in traffic and congestion on arterial streets, there is greater need for travel data in urban areas. Comprehensive metropolitan-area transportation studies of the type described in previous annual reports are either under way or have been completed in 85 metropolitan areas in 33 States. Eight of these studies were started during the fiscal year.

Data collected provide information concerning the origins and destinations of traffic and other facts essential in the location and design of new arterial routes. In addition to these uses, the data are analyzed for significant facts relative to highway transportation in general. For example, from a study of the travel data collected in 38 cities, involving more than 17 million trips, it has been found that 34 percent of the trips were made by mass transit while the remaining 66 percent were made in private automobiles and taxis.

This year a new study of travel on superior arterial routes in urban areas has been initiated with the following purposes in mind:

1. To determine the amount of traffic, under different circumstances, that will be diverted from existing roads and streets to a new arterial route which provides improved travel conditions.
2. To determine the amount of travel that is generated by a newly constructed or improved route. It is definitely known that a new route generates a certain amount of travel that did not occur before the improvement was placed in service, but the relative amount of increase has been unknown.
3. To develop a reliable basis for estimating the volume of traffic which may be expected to use new routes on locations where previously no facility existed.

To achieve these purposes it is necessary to obtain the origins and destinations of vehicle operators using existing arterial routes that offer superior driving conditions and, in addition, to conduct "before-and-after" origin and destination studies in areas where new routes are being constructed. The necessary data are collected by stopping and interviewing a representative sample of the drivers. Definite plans for research of this nature were made in 10 cities and work was contemplated in several more. Actual field operations began in three cities.

The Bureau, in its studies of urban traffic patterns, has found that the increased use of motor vehicles is rapidly changing the social-economic pattern of our urban areas. As part of its responsibility in planning urban routes, specialized studies were begun to determine and measure changes in expanding suburban areas. These studies, when correlated to land-use characteristics, will provide procedures and criteria to assist in the long-range plans and programs for urban highway systems. Studies were initiated (1) to estimate the volume, characteristics, and length of work trips from large multiple housing projects; (2) to analyze the effect upon employee travel where large employment centers are relocated from urban to suburban locations; and (3) to measure and correlate the attraction of traffic by the central business district and suburban commercial centers, with respect to purpose of trips, mode of travel, and area from which drawn.

On the basic premise that one of the major factors affecting urban traffic is the generative nature of cities' individual and collective land uses, the Bureau, in cooperation with the Institute for Urban Land Use and Housing Studies of Columbia University, is conducting an exploratory study in Philadelphia. The purpose is to formulate and test methods for obtaining data pertaining to movements of persons and goods in relation to various kinds, locations, and characteristics of urban land uses, which will aid in the evaluation of highway requirements for such movements.

Parking and terminal facilities

Comprehensive studies to measure parking needs accurately have now been made or are under way in 62 cities in 29 States in cooperation with State highway departments and city authorities. With the tremendous postwar increases in traffic volumes there has come an increasing realization in the cities of the necessity for terminal facilities as an aid in relieving congestion. While this has long been evident, action programs for parking have lagged behind other traffic improvement measures, largely because municipalities have not had agencies clearly charged with responsibility. The interrelation of passenger-car storage, truck-freight handling, and traffic movement have now become more evident, and more and more cities are recognizing their responsibility by first obtaining facts necessary for planning an improvement program and for assigning definite responsibility for activating a program.

Rural travel habits and road usage

The problems of selection of those local rural roads which should be improved and maintained in preference to others, and of developing a rational method of financing such programs, have been the subject of several studies under way during the past fiscal year.

In cooperation with the University of Virginia, the Virginia Military Institute, and the Virginia State Department of Highways, the Bureau is studying the effects of the establishment of an entirely new industry in an area which previously had been entirely rural in character. Highways are used exclusively for transportation to this plant. Effects on the social and economic patterns of living will be observed as well as effects on travel habits, highways, and road structures.

A preliminary report has been prepared on usage of rural roads in Logan County, Colo., where all residents in rural areas were interviewed. This report shows that all farms and rural homes benefit directly from a system of principal rural roads although perhaps a majority of the homes do not have direct access to this limited system. In Logan County about 20 percent of the roads may be considered as principal roads and 82 percent of all travel by all rural residents was on this system. Two percent of the population lived 5 miles or more from any route of this system and 51 percent of the travel by this group was on the system. Thirty-four percent of all rural dwellings was located on the system.

The usage of rural roads in providing distribution and collection route services was studied in two Maryland counties. In one county 90 percent of all rural mileage is used for some kind of route service. Rural mail delivery routes cover 75 percent of all rural roads, petroleum product deliveries 60 percent, commercial milk collection 51 percent, and school-bus routes 44 percent.

The opportunity presented by these studies has been used to obtain the opinion of rural residents with respect to improvement of roads to which they have access and to their willingness to assume more financial responsibility for local road improvements. Approximately 70 percent of those residents on roads considered unsatisfactory indicated that they were willing to pay for improving those roads and almost as many were willing to do the same thing for roads by the property of others similarly situated. As might be expected, those living on well-improved roads were less inclined to favor increased taxes for local road improvement. Slightly more than 50 percent were found to be willing to pay property taxes for local road improvement.

Toll roads

The opening of a 42-mile toll highway along the coast of Maine from Kittery to Portland presented the opportunity for a study of the effect of such a facility on traffic on the parallel toll-free public highway (approximately the same length as the toll highway).

Before the toll highway was opened, a comprehensive traffic survey, including origins and destinations, was made on U S 1, the parallel route. The toll road was opened to public travel December 13, 1947, and since then surveys have been repeated on U S 1 and on the toll highway, and these surveys will be continued into the next fiscal year. They are being conducted in cooperation with the Maine State Highway Commission and the officials of the Maine Turnpike Authority. One of the important uses of surveys of this character will be in estimating traffic on toll roads proposed in the future. Similar studies are being made on the New Hampshire toll road and the east and west extensions of the Pennsylvania Turnpike.

Consideration was given to a traffic study in the area adjacent to the New Jersey Turnpike, being built as a toll road. Traffic recorders were placed on numerous highways where it was anticipated that there would be a change in traffic volume and character after the toll facility is placed in operation. Due to the heavy traffic volumes in this area, an origin and destination survey was not contemplated, but other research approaches to the problem were considered.

In Ohio the Bureau is cooperating with the State Department of Highways in planning a survey in the area which may be influenced by the toll highway proposed to connect with the Pennsylvania Turnpike.

Unbalanced traffic flow controls

Since traffic volumes are not usually balanced in both directions during the periods of heaviest flow, losses in efficiency occur because one-half of the roadway is overtaxed while the other half operates at only partial capacity. Three-lane and undivided four-lane highways can sometimes be operated under controls that restrict the use of more than half of the lanes to vehicles traveling in the direction of heavier movement.

The meager information available on the merits of unbalanced flow control led to a before-and-after type of study in cooperation with the Virginia State Department of Highways. On the three-lane route selected, volumes were in the ratio of 81 to 19 in the morning peak hour and 25 to 75 in the evening peak hour. Studies of the time required to traverse the 1.6-mile three-lane section, the delay at intersections, and other operating characteristics were conducted. Following this, a system of interconnected semi-traffic-actuated signals was installed at the 12 intersections and operated with supervisory background cycle control. Each lane along the route was provided with its own signal indication, and the signals were operated so that traffic in the direction of heavier travel in the rush periods could utilize two of the three lanes of the roadway. The effects of this unique method of control are being analyzed to determine its value on congested sections of roadway where immediate relief through new construction is not possible.

Highway capacity

The results of a comprehensive analysis of a great volume of data relating to highway capacities obtained through the cooperative efforts of the Bureau of

Public Roads, the Highway Research Board Committee on Highway Capacity, and many State, county, and city engineers during the past several years were published under one cover as a *Highway Capacity Manual.* The manual is a practical guide with which a new highway can be designed or an old one revamped with assurance that the resulting actual capacity will be as calculated.

The information on traffic capacity under various conditions, particularly at street intersections, has many applications in planning relief from congestion in the larger cities. The capacity of an entire street system of a city can be estimated with reasonable accuracy and compared with the existing or estimated future demand to determine the most feasible improvements required, if any, whether they be changes in traffic control, widening of existing streets, construction of new facilities, or a combination of two or more of these alternatives. Such an analysis was completed in Albuquerque, N. Mex., with technical assistance from the Bureau. A similar study was begun in Denver, Colo.

Motor-vehicle performance

The ability of all types of motor vehicles to perform on the highway must be clearly defined before it is possible to design highways and regulate their use with assurance of safe and efficient movement of all traffic. The Bureau has, for many years, pioneered research in cooperation with various organizations concerned with highway transportation to obtain factual information on the several phases of vehicle performance. Research projects have been initiated to determine for vehicles of various types the hill-climbing, down-grade, and level-road ability in terms of speed and power; the forces that oppose the motion of motor vehicles such as air and rolling resistances; the braking ability in terms of stopping distance; the turning ability in terms of off-tracking or turning width and radius of curvature; and the direct operating costs of commercial motor vehicles.

The factual data being obtained are important in the development of highway facilities that harmonize with the performance of vehicles, in the formulation of practical regulatory measures that will insure safety and yet not work economic hardships on the operators of vehicles, and in the determination of the proper economic relation between the cost of providing highway facilities and the cost of operating the vehicles that use the facilities. The increasing importance of commercial transportation and the heavy demands it imposes on existing and new highway facilities have made it necessary to give priority to the study of performance of commercial vehicles. Work during the fiscal year was largely concentrated on the braking ability and the operating costs of commercial vehicles.

Brake research

An extensive program of brake research has been organized with the advice of an advisory committee composed of representatives of the Interstate Commerce Commission, the National Bureau of Standards, the Department of the Army, and 19 other agencies including the major associations of highway officials, motor-vehicle manufacturers, automotive parts and equipment manufacturers, and motor-vehicle operators.

It has three main phases: (1) tests on vehicles in service, selected at random from the general traffic, (2) controlled tests on new commercial vehicles, and (3) controlled tests on used commercial vehicles.

The Bureau is responsible for the collection and analysis of data for phases 1 and 3. The Automobile Manufacturers Association's Brake Technical Committee is undertaking the phase 2 tests, using test procedures adopted in the Bureau's research program. The data obtained by the Association will be correlated with the results of tests from phases 1 and 3.

The field work on phase 1 has been completed. Some 1,200 vehicles, including about 300 passenger cars, have been tested at locations in Maryland, Michigan, and California. Phase 3 tests have been conducted with the assistance of 23 operators on the West Coast, 9 operators in the southeastern area of the country, and 7 operators in the eastern area of the country, and will be conducted with 7 operators in the Middle West. The field work will be completed by October 1950, and a report will then be prepared.

Operating cost research

After more than a year and a half of study and analysis, a comprehensive report on the gasoline consumption and travel time of commercial vehicles was prepared and reported to the Highway Research Board. The report discussed the actual operation of seven heavy commercial vehicles with gross vehicle weights varying from 20,000 to 140,000 pounds, over sections of highway with various grade characteristics.

The findings make it possible to compute the travel time and gasoline consumption of a vehicle of given power with a given load when the rise and fall and length of the highway to be used are known. Determinations may be made for a highway of any length without considering each individual grade separately.

The report is a definite contribution toward the solution of the economic problem of motor-vehicle size and weight. Studies to determine the other segments of vehicle operating costs (maintenance, tires, overhead, etc.) are being initiated.

Accident studies

Highway conditions that are conducive to accidents have always been of concern to engineers. The Bureau joined with the National Safety Council about 5 years ago in devising and applying a research technique for study of this problem. Approximately 15 States cooperated in the undertaking, and tentative findings were reported late in 1946. Since that time certain additional data have been assembled by the States, and active work has been resumed on the analysis of the total information now at hand.

The earlier findings indicated that isolated curves of only moderate sharpness were several times more hazardous than curves of the same sharpness that were part of a generally winding alinement. Other data were developed to show the effect of traffic volume on accident frequency on various types of highways, and the accident frequency for various surface widths, structure widths, and intersection types. Corroboration and expansion of the preliminary findings will provide important guides for design and operation of highways in the future.

In addition to these studies, the Bureau is cooperating with a number of States on roadside inventory projects. In Minnesota and Michigan, where this work is furthest advanced, an important phase is study of the association of accident locations with driveways and other access points, as well as advertising signs and establishments along the roadside. From the work done thus far, it is evident that the character and intensity of roadside development bear a closer relation to accident occurrence than is commonly supposed. The studies are designed to reveal the significance of the several types of roadside use so that proper measures may be taken to protect the public's investment in the highway.

Financial and Administrative Research

In every State conducting highway needs studies, methods of providing additional funds eventually become a major issue. The debates that take place and conflicting data offered underline the necessity for intensive research in the interrelated fields of highway costs, finance, and administration. In cooperation with the State highway departments and with national organizations, the Bureau has continued and moderately expanded its studies in this general category during the past year.

Financial studies

The number of States cooperating in the annual collection and reporting of information regarding the financing of highways and streets by counties and local rural and urban governments continued to increase. By the end of the fiscal year, more than 40 States were participating in this work. All States regularly report to the Bureau data on State taxation of motor vehicles, mileage completed, motor-vehicle registrations, and related data. The information now being obtained for city and local rural units is essential to give a complete picture of the highway situation.

Analysis and tabulation of the county and local road finance information on a Nation-wide basis were continued, as was preparation of estimates of the highway operations of the local governments in the States that had not yet undertaken this work. Considerable progress was made in the preparation of a report covering the receipts, disbursements, and debt of counties and local rural governments for the years 1942–47. This report will supplement *The Financing of Highways by Counties and Local Rural Governments, 1931–41,* published in December 1949. A similar report presenting information on city and village street financing was also in preparation. A preliminary estimate of the receipts and disbursements for highway purposes of all classes of governmental units during 1949 was prepared and previous estimates for the years 1945–48 were revised.

Highway costs

Cooperative studies by the Bureau and State highway departments of construction costs, maintenance costs, and the service lives of the various highway surface types were continued.

Pilot studies involving analyses of highway construction investment data were carried out, and probable weighted-average service lives of capital improvements were developed. In cooperation with the highway departments of Kentucky, Minnesota, and Texas, work was done in developing procedures for determining the annual operating cost of a section of highway. A progress report on this work was made to the Highway Research Board.

From detailed analyses of the service lives of various road types, data were assembled which indicate the rate at which the Nation's road systems are wearing out. It was found that within 10 years 44 percent of the high-type mileage now on the Federal-aid primary system will wear out. The total of this type on January 1, 1950, was 109,000 miles, of which 48,000 miles will wear out by 1960.

The indicated need of total surface replacement of other surfaces on the Federal-aid primary system in the same 10-year period was 76,000 miles. The 8,700 miles of unsurfaced roads should also be surfaced: hence the total indicated need for all Federal-aid primary roads combined was found to be 132,700 miles of replacement in the next 10 years.

Several States conducting long-range highway needs studies were assisted in setting up a replacement program, determining work volume, calculating the annual costs for various program periods, and estimating the necessary revenue to bring the several highway systems up to standard.

Assistance was given to several State highway departments in establishing highway control sections. Control sections are fixed, permanent sections of highway or street systems selected from the viewpoint of convenience in assembly of a large amount of diversified information pertaining to their upkeep and performance. Uniform cost and operation reporting procedures and accounting methods were established as a part of the control-section study.

Production cost studies

The purpose of production cost studies is to point out ways in which construction and maintenance supervisors can increase the efficiency of their operations and thus reduce highway costs. Studies of equipment performance and construction methods were conducted on 18 construction jobs in Eastern and Midwestern States. Pilot studies of county maintenance equipment and methods were made in five counties in Mississippi, Tennessee, and Texas. A 1-year study of equipment utilization and performance on State highway maintenance has been started in Connecticut.

Studies of the operation of trucks hauling bituminous mixtures showed that each truck spent an average total of over 13 minutes at the plant obtaining a load and at the finisher discharging. Waits and delays per trip averaged over 18 minutes. The accumulation of such delays adds materially to highway costs.

Studies made on jobs employing scrapers drawn by both rubber-tired and crawler tractors disclosed that the average pay load per unit ranged from 56 to 106 percent of rated capacity, with an average of slightly over 80 percent. Haul speeds for the rubber-tired tractor units averaged 676 feet per minute and for the crawler tractor units 322 feet per minute. Delays to these units resulted principally from weather conditions, amounting to 54 percent of available time for rubber-tired tractors and 25 percent for crawler tractors.

Studies of a large excavating and loading machine revealed that the unit excavated material at an average of 1,035 cubic yards per hour, exclusive of delays. When allowance was made for time lost in turning and waiting for trucks to get in position for loading, the rate was reduced to 705 cubic yards per hour.

Studies of county maintenance operations revealed a great variety of working conditions and problems. The principal machine used was the motor grader, which was found to be utilized on actual productive work for only 47 percent of the total available working time. Tractor front-end loaders on county work were utilized 16 percent of available working time. A shortage of hauling units accounted for the largest delays encountered and amounted to over 20 percent of the total available working time. Power shovels engaged on county work were utilized 37 percent of the total available working time. Here a shortage of hauling units accounted for by far the largest delays, amounting to 27 percent of the total available working time.

Facts disclosed by these studies are being made available to contractors, equipment manufacturers, engineers, and others through releases by the Highway Research Board. There has been considerable interest in these reports not only within the United States but also in several foreign countries.

Highway administration

A comprehensive study of State highway department administrative bodies was completed. The general purpose was to describe accurately the various types of administrative organization and complementary provisions, such as qualifications of members, tenure of office, method of appointment, and related matters.

The study of existing civil service, merit, pension, and retirement systems under which State highway departments operate, and a complementary study of workmen's compensation laws as they affect State highway departments, were completed and the data tabulated. Preparation of reports to accompany the tabular data was begun.

Land acquisition, roadside control, and terminal facilities

Research in connection with requirements for off-street truck loading and unloading facilities as contained in zoning ordinances, building codes, or other local laws, has been completed and the provisions have been analyzed. Work on a report was begun. Cities planning to provide more adequate parking facilities were assisted in solution of legal, administrative, and financial problems. Existing machinery and practices were analyzed and evaluated and recommendations made.

Research and analysis of State enabling acts, of both general and local application, authorizing provision of off-street automobile parking facilities were completed for the years 1946–49. Studies embodying the findings will revise and bring up to date the original studies covering laws of like nature enacted up to and including 1945.

A report on the use of parking-meter revenues was completed, with an appended digest of the State statutes on court decisions relating to the subject. Legal research on the validity of regulating off-street parking facilities as public utilities was completed and work begun on a report.

A report dealing with the financing of highway rights-of-way was completed, in cooperation with a committe of the American Association of State Highway Officials. This report was based on returns to the committee's questionnaire on State land-acquisition procedures.

A study of the effect of the new Shirley Memorial Highway in Virginia on land use and land values was commenced, from which it is hoped that a technique or method of study may be developed which may be used in connection with similar studies undertaken in various parts of the country. The Shirley Highway is a four-lane express highway with controlled access, built on an entirely new location.

Administrative methods of controlling development of roadsides were studied and discussed in a report. The roadside surveys made to determine the character of existing development and its possible relation to accidents on the highways were utilized in the administrative study. Methods of control considered included the formulation of design standards for entrances and exits, and adoption of a permit or licensing system for controlling the number and location of entrances and exits. A bibliography on roadside control was completed and published.

Assistance on matters relating to legal control and administrative authority was extended to a subcommittee of the American Association of State Highway Officials in the preparation of a policy statement on drive-in theaters.

Information regarding current legislation, court decisions, and administrative practices in the field of land acquisition and control of highway access and adjacent areas was compiled for publication by the Highway Research Board.

Report on the local rural road problem

In 1949 two bills were introduced in the Senate to provide regular authorizations of Federal funds for the construction of local rural roads. Conflicting data and opinions presented during the course of hearings indicated the desirability of a factual appraisal of the economic, engineering, financial, and administrative phases of the local rural road problem. Such a study was undertaken by the Bureau at the request of the Senate Committee on Public Works. A report entitled *The Local Rural Road Problem* was presented to the committee in January.

The report discussed four main subjects: (1) extent and usage of local rural roads, (2) required improvement and its cost, (3) local road finance, and (4) local road administration.

Of the 2.5 million miles of local rural roads, approximately half are surfaced; and of the unsurfaced roads as many as 400,000 miles might be classed as unessential. About 64 percent of all farms are on all-weather roads, and the proportion of farms that had such access was twice the proportion that had telephones or running water. Local rural roads were found to have an average traffic volume of about 56 vehicles per day but approximately 40 percent of the local rural road mileage carries 10 or less vehicles per day. Farmers use all classes of rural roads and city streets. More than half the travel of farm passenger cars and trucks was on primary highways and city streets.

The report reviews standards of improvement and requirements with respect to the maintenance and operation of local rural roads and develops the average annual cost of alternate programs ranging from $894 million per year for a 20-year program to $1,269 million per year for a 10-year program, including construction, maintenance, administration, and engineering.

The discussion of local road financing shows some striking trends. On a Nation-wide basis, the local highway units have enjoyed considerable success in shifting their financial burdens to the State and Federal Governments. From 1927 to 1947, the relative contribution made to the support of local roads by counties and local units has been cut more than half, from 81 to 39 percent. In 1947, the percentage of the $835-million revenue received from various governmental sources for the support of local rural roads was as follows: Federal sources, 4 percent; State sources, 57 percent; and local sources, 39 percent.

The report points out weaknesses in existing administrative set-ups. It indicates a need for clear specification of legislative intent and improved State-local relations. It describes the advantages of a State-aid program managed by the local units with State assistance in planning, establishing priorities of improvement, and selecting road systems. Over 18,000 local governmental units were found to exercise jurisdiction to some extent over local rural roads.

Hydraulic Research

One of the uncertainties frequently faced by field engineers is the extent to which the sand or gravel in a stream bed may be scoured out around bridge piers and abutments during floods. Underscour is one of the principal causes of destruction of bridges. When a determination must be made as to probable depth of scour, it is generally based on experience with other structures under similar conditions. To develop a more scientific approach to the problem two research projects have been undertaken, one in Iowa and another in Colorado.

The Iowa Institute of Hydraulic Research at Iowa City, under an agreement with the Iowa State Highway Commission for a Federal-aid research project, has been making tests on models of bridge piers placed in a laboratory flume having a sand bottom. These tests are indicating, among other things, that the angle at which the current approaches the pier greatly affects the depth of the localized scour. A new flume has been constructed in which sand is kept moving along the bed just as sediment moves in a natural stream. The Bureau has assigned an engineer to this project who will later supervise field observations of scour around actual bridge piers to verify the theories developed from laboratory study.

The Rocky Mountain Hydraulic Laboratory, a nonprofit corporation formed by a group of prominent hydraulic engineers, is cooperating with the Bureau in investigating the use of flexible mats to reduce scour around bridge piers. Preliminary tests indicated that the depth of scour around a bridge pier can be greatly reduced if a flexible mat capable of adjusting itself to the changes in the bed of the stream during flood stages is placed around the base of the pier. The object of the investigation is to learn more about the characteristics of such mats, which are expected to be useful in protecting existing bridges against destruction by underscour as well as providing an additional factor of safety for new bridges.

The effectiveness of pipelines for removal of storm water from express highways may be adversely affected by the deposition of sediment in the pipe. The cost of cleaning clogged pipes can be large. Very little is known about the critical conditions causing sediment to deposit in a pipeline. The Iowa Institute of Hydraulic Research is cooperating with the Bureau in a study of this problem. Use of sediment-trapping devices will be investigated.

The University of Illinois is cooperating with the Bureau in a study to develop improved structures for collecting and disposing of storm waters on express highways and to develop improved methods of estimating the probable amounts of rainfall that may be expected.

The research described is aimed at filling in gaps in knowledge of how water flows through highway drainage structures. Review is continuing of information available from highway sources and from other agencies concerned with the flow of water. Close cooperation is maintained with the United States Geological Survey, particularly with respect to encouraging the analysis of existing stream-flow records for the purpose of statistical determinations of the magnitude and frequency of flood flows. A number of State highway departments have entered into cooperative agreements with the Geological Survey for studies of flood frequencies and also for the installation and operation of gaging stations on typical small watersheds for which insufficient peak runoff data are available.

An intensive study of data on peak rates of runoff from small watersheds is being conducted. Data are available primarily from the investigations of the Soil Conservation Service which, unfortunately, are applicable to a very limited portion of the United States and include no indication of rates of runoff on very flat land.

Through representation on the subcommittee on hydrology of the Federal Inter-Agency River Basin Committee, deficiencies in basic hydrologic data needed for highway purposes are being correlated with the needs of other Federal agencies. Hydraulic engineers of the Bureau assisted in the work of the interagency committees developing information for the President's Water Resources Policy Commission.

Work on the preparation of a drainage manual was continued. It is believed that marked improvements can be made in drainage features of highways with resulting reductions in highway costs and fewer interruptions to traffic by floods. The purpose of the manual is to place in the hands of field engineers the latest research results on determining the flow of water to be expected under different conditions and on the most efficient hydraulic designs to handle the flow.

Physical Research

Activity in the physical research field continued as rapidly as facilities permitted during the past year. Much of the work is of a continuing nature, and the more important projects under way have been described in previous reports. This report will discuss progress made during the year on each of the continuing projects and describe new activities that have been undertaken.

In addition to activities of a strictly research nature, the laboratories performed a substantial amount of routine testing for other Government agencies as well as in connection with work under the direct supervision of the Bureau.

The instruction of groups of highway engineers from organizations in this country, from foreign countries, and of the Bureau's engineering trainees, has been continued on an enlarged scale.

Cooperation was continued with engineering organizations standardizing specifications for road materials and methods of testing and interested in research along these lines. Such organizations include the Federal Specification Board, the Highway Research Board, the American Society for Testing Materials, the American Concrete Institute, the American Association of State Highway Officials, and others. Cooperation by the Bureau takes the form of active participation in committee work by individual members of the staff as well as participation in cooperative programs of research sponsored by these organizations.

Soil studies

Considerable progress has been made in the development of methods suitable for the preparation of engineering soil and drainage maps from aerial photographs, geological maps, and agricultural soil maps. Research mapping projects in cooperation with the Maine and New Jersey State highway departments have been continued. The trial project in Maine has been completed and reported. On the basis of information obtained, additional research work has been started to develop methods for mapping other types of soil and drainage conditions found in that State. In New Jersey, over 50 percent of the State has been mapped and soil reports and maps have been prepared or were in the process of preparation for publication. These maps and reports describe the methods developed for airphoto interpretation and show the distribution of soils apt to require similar treatment from an engineering standpoint.

As a result of research work on mapping of soils for engineering purposes using aerial photography, the training course for young engineers employed by the Bureau has been expanded to include a course in airphoto interpretation of soils. This course will be given to all trainees to acquaint them with the most recent development in this specialized field.

Training of enlisted personnel of the Army in soil testing was continued. Three 8-week courses of instruction were completed. The purpose was to train men in the methods of soil testing for future assignments in the construction of military roads and airfields. During this same period a number of State and county engineers were given specialized instruction in soil testing as applied to highway and bridge design.

Work in soil mechanics consisted of shear, consolidation, and permeability testing of soils in connection with the design of foundations for Veterans' Administration hospitals at a number of locations. Soil testing was continued in connection with the foundation design of the White House and for bridges in the District of Columbia.

The construction and preliminary soil work on the cooperative experimental concrete pavement in Indiana has been completed. This project was initiated to study the effect of several methods of pavement design in minimizing the detrimental effect of pavement pumping under heavy highway loads. A report describing the soil conditions and the methods used for subgrade improvement was being prepared. Subsequent reports will indicate the effectiveness of methods of subgrade treatment.

The testing of base course and subgrade at the Hybla Valley test track near Washington was continued. The effectiveness of various types of moisture cells to measure the movement of soil moisture in the subgrade and base course was studied in connection with this field study of nonrigid pavement design.

The laboratory study of chemical deflocculating agents in soil dispersion was continued. A report describing the development of a new air-jet type soil dispersion apparatus was published. The apparatus is being used by several testing laboratories in the mechanical analysis of soils.

Fundamental research has been started in a study of clay minerals found in soils. Work with the electron microscope has been started, and other basic research by thermoanalysis and with the spectrophotometer and X-ray diffraction will follow. The objective is to determine more satisfactory methods of evaluating local soils as construction materials for secondary roads.

Bituminous materials and mixtures

One of the most important considerations in the field of bituminous construction is the durability of bituminous pavements. An important factor affecting this property is the quality of the asphalt used and its ability to retain its adhesive properties and its resistance to hardening in service. These characteristics differ among asphalts produced from a given crude oil and refined by different processes.

In the study of these properties that is currently being made, an abrasion test is used. Asphalts, combined with Ottawa sand, are formed into test specimens, subjected to controlled accelerated weathering, and then subjected to an abrasion test. Preliminary results show that this method will evaluate asphaltic materials in terms of their resistance to hardening and will differentiate between positive-spot and negative-spot materials produced from a given crude oil. Comparison of materials from different crudes is not yet warranted on the basis of the results thus far obtained. A preliminary report of this investigation was presented at the 1950 annual meeting of the Association of Asphalt Paving Technologists.

Chemical additives.—The value of certain chemical additives in increasing the adhesion of asphalt films to stone particles is believed to be decreased by high temperature and long periods of heating to which asphalts containing them may be subjected. A study of the resistance of treated asphalts to the action of heat has been carried on in the laboratory on a number of asphalts and chemical additives. The indications are that these materials differ greatly as to the effect of heat and length of heating. New types of additives claimed to be heat-resistant have been included in the study.

Special investigations.—Several experimental sections of bituminous surface containing rubber powders, in addition to those already reported, have been installed by the State highway departments of Ohio and Texas. Observers from the Bureau were present during the construction of these test sections. Samples of the component materials and of the finished mixtures were tested in the laboratory. Although the effect of the rubber powders on skid resistance and lower maintenance costs of the surfaces can best be evaluated by continuing study of the experimental sections in the field, it is expected that the laboratory tests already made and those to follow will lead to a better understanding of asphalt-rubber blends.

Another field project has been added to the group of bituminous concrete surfaces being studied in cooperation with several State highway departments. Among the properties of the pavement being studied are correlation of progressive degradation of the aggregate with the results of the Los Angeles abrasion test, increasing density under traffic and its effect on pavement behavior, and the alteration of certain test characteristics of the asphalt with age.

During the year, the laboratory has been requested to design bituminous mixtures for use in various regions, utilizing local aggregates. The susceptibility of mixtures containing particular aggregates to water action, the selection of additive treatments when indicated, and the adequacy of stability developed by these mixtures are important factors in designing mixtures that can be expected to give satisfactory service performance. These investigations have brought out the wide range in test characteristics of aggregates from different sources, particularly with respect to the effect of water on bituminous mixtures in which they are used.

Fillers.—A study of the use of certain waste materials as fillers for bituminous mixtures is in progress. Trap-rock dust and fly-ash, which are in plentiful supply in certain areas, are being investigated as replacements for or to supplement the more expensive fillers such as portland cement and limestone dust. Results thus far obtained indicate that certain trap-rock dusts as well as fly-ash from some coal-burning, steam-electric power plants are the equal of the usual fillers specified. Both of these products are waste materials and their use in bituminous construction should prove economical and at the same time effect a considerable saving of materials needed for other purposes.

Chemical analyses.—A method for determining the sodium and potassium in soils and other siliceous materials by means of a flame photometer was developed and a report prepared for publication. This method is simpler and much more rapid than the usual gravimetric method of determination.

A modification of the standard paint specification for shop primers of the red-lead, iron-oxide type was developed for use on bridge steel fabricated in this country and shipped to the Philippines. This special paint was designed to provide a coating adequate to resist damage in the handling incurred in overseas shipment. It proved to be more satisfactory for this particular purpose than did paint furnished under the standard specifications.

Cement, aggregates, and concrete

The major research effort in connection with studies of portland cement and aggregates continues to center around the phenomenon of the alkali-aggregate reaction. Many projects which were initiated in previous years and which have been described in earlier reports are still active. This is due to the discovery that certain combinations of cement and aggregate may not begin to react until after as much as 4 years of storage. It appears from this indication that the 1-year storage period, which has been considered ample, may not be sufficient.

One of the most important of these projects concerns the degree to which various cements will react with a given reactive aggregate such as opal. By testing a great many cements it is hoped that information will be obtained which will aid in determining what other factors in addition to the amount of alkali may influence the reactivity of the cement. During the past year this project has been extended to include numerous portland cements of varying alkali content, and additional data have been obtained.

Another investigation concerned the reactivity of slag aggregates with high-alkali cements. Since many slag particles have the property of fluorescing under ultraviolet light, the slag samples were separated according to their color under this type of light. Separated fractions were then tested for reactivity with high-alkali cements. At present, indications are that the color under ultraviolet light is less significant than the source of the product.

An investigation of types of containers other than mason jars for determining volume changes due to alkali reactivity was completed. It was found that a large-size incandescent light bulb could be converted into a satisfactory container which would indicate volume changes of mortar more quickly and with more uniformity than a mason jar. However, the inconvenience of preparing and handling of light bulbs will probably limit their usefulness in this particular test.

The effect of various calcareous additives on the strength and durability of cement mortars was investigated. This investigation was inaugurated because of certain European data which indicated that the addition of calcite to concrete would greatly increase its resistance to weathering and salt attack. The calcareous materials studied were pure calcium carbonate, ground limestone, ground marble, and hydrated lime. The results did not show any significant improvement in the properties of mortars containing these additives. This work may be extended to include these same materials ground much finer than in the initial tests.

In 1940, a study of the durability of concrete as affected by the cement was inaugurated. Concrete specimens containing 60 portland cements, differing widely in their physical and chemical properties, were fabricated and stored out-of-doors. A number of these specimens have now disintegrated either in whole or in part. Samples of clinker from which each of the cements was made have been examined and, in addition, small mortar cylinders prepared with these cements have been tested for compressive strength after 10 years storage in air and water. A summation of the data is being prepared for publication.

During the year, several occurrences of slippery concrete pavement were brought to the attention of the laboratory. Samples of limestone from Pennsylvania which, when used as both fine and coarse aggregates, produced slippery surfaces, were examined. It was discovered that these limestones contain somewhat larger amounts of carbonaceous material than do more satisfactory limestones of the same general type. Further work on this problem is being planned.

During the year the petrographic laboratory devised a method for determining the amount of mica in soil. The procedure consists of placing a static electrical charge on a camel-hair brush which is then passed over the soil sample. The particles of mica are attracted to the brush and thus removed. It is proposed to extend this method to the testing of fine aggregates for concrete.

Researches in portland cement concrete continue to be directed primarily to the problem of improving durability or resistance to natural weathering. The introduction of the principle of air entrainment in concrete to improve durability is generally recognized as the most important contribution to the art that has been made during the last 20 years. However, the use of air entrainment has raised numerous questions regarding its effect on various properties of the concrete, on mix-design methods, etc. To answer some of these questions, a number of laboratory and field investigations covering various phases of the problem are being continued or were initiated during the past year.

One of the most important of these is a cooperative investigation to obtain data for use in preparing tables of proportions for air-entrained concrete. This work, in cooperation with several governmental and private laboratories, was carried out primarily for the use of a committee of the American Concrete Institute. The variables studied included cement content, workability factor, sand content, water-cement ratio, and strength. All the experimental work on this project has been completed and a report is being prepared.

The growing use of air-entrained concrete has resulted in the introduction of numerous proprietary compounds which are being promoted as air-entraining admixtures. To assist in the evaluation of these materials, a questionnaire was sent to all known manufacturers requesting samples and information regarding composition, amounts required for a given air content, and laboratory and field test data indicating performance. About 23 admixtures have been received and tested to determine their air-entraining properties and their effect on strength. The resulting information will be used in considering materials for Federal-aid work.

It has become apparent that the lag between discovery of principles that govern concrete performance and their application in field practice is increasing. As a step toward closing this gap, the Bureau has arranged with the Ohio State

Department of Highways to construct an experimental concrete pavement to demonstrate the practicability of using dry, low-sanded mixtures, compacted thoroughly by vibration, in place of the comparatively wet mixes now in common use.

Other field experiments in which the Bureau is interested are being conducted in Kansas to determine the comparative merits of the modern portland cements as compared with the kind of cement manufactured 25 or more years ago, and in Nebraska to develop information regarding the possibility of using fly-ash to reduce expansion caused by the alkali-aggregate reaction.

An extensive series of laboratory tests is under way to determine the relative efficiency of curing with water as compared with the modern method of spraying the surface of concrete with a nonbituminous liquid curing compound. Two methods of determining the relative efficiency are (1) determining the resistance of the concrete to freezing and thawing, and (2) determining the resistance to scaling resulting from the use of calcium chloride for melting ice formed on the surface. Also, in connection with the application of research to field conditions, a series of tests was undertaken to demonstrate the relation between consistency of concrete and durability. Three cement contents, two cements, two types of coarse aggregate, and two air contents are being studied.

Tests were made in the Bureau laboratory to determine the cause of deterioration of concrete in eastern Oklahoma, using test specimens made with three cements—two from Oklahoma and one obtained in Washington, D. C. Three aggregates from Oklahoma and sand and gravel from the Washington area were included. The tests cover freezing and thawing, wetting and drying, and determinations of thermal coefficient of expansion of the various combinations.

Several projects mentioned in previous reports have been continued. Under this classification are included the extensive project initiated in 1947 covering the strength, durability, permeability, and shrinkage characteristics of concrete containing three typical commercial air-entraining portland cements. The examination and testing of concrete cores from the German Autobahnen have been completed, except for the determination of air voids in the concrete, using a newly developed microscopic method.

The long-time study of cement performance in concrete, described in detail in previous annual reports, has been continued. Periodic inspections have been made of the concrete test specimens exposed to weathering at the laboratory as well as inspections of the full-size experimental installations in the field. This investigation holds great promise of leading ultimately to the adoption of more satisfactory specifications for portland cement for highway construction.

The long-time study of the volume change of concrete exposed to alternate heating and cooling was continued. These tests were made in connection with the problem of concrete durability in certain midwestern States.

Structural design investigations

Rigid pavements.—Studies of the performance of six experimental concrete pavements in California, Kentucky, Michigan, Minnesota, Missouri, and Oregon were continued. These pavements, constructed cooperatively in 1940 and 1941, were primarily intended to develop information as to the amount of expansion space necessary in concrete pavements. The information obtained has led to a modification of design practice on this detail. A 10-year report on the six projects is being organized as a group of papers for presentation before the Highway Research Board.

Mention has been made in previous annual reports of the study of the effect of various amounts of longitudinal steel reinforcement in concrete pavements being conducted near Stilesville, Ind., as a joint undertaking of the Bureau and the Indiana State Highway Commission. During the past year a report giving the results of 10 years of systematic observation of these experimental sections was prepared and presented jointly by the State and the Bureau before the Highway Research Board.

In the laboratory the structural design of joints for concrete pavements is being given continued study. A systematic program of repeated load testing in a special machine developed by the Bureau for the purpose has already produced important information not heretofore available on the effect of variation in design detail on the structural efficiency of some types of load transfer installations.

A very important road test to determine the effect of heavy loads was initiated in June 1950 on a 1.1-mile section of concrete pavement located on U S 301 south of La Plata, Md. This test is being conducted under the direction of the Highway Research Board as a cooperative undertaking of 11 eastern States, the District of Columbia, and the Bureau of Public Roads, with assistance from commercial organizations in the highway transport field. No test exactly like it has ever been made, and its results are awaited with keen interest by all highway authorities and by commercial trucking and other transportation interests.

There will be repeated applications of heavy axle loads of fixed magnitudes at average intervals of less than a minute, for at least 6 months. The loads are being applied by eight test trucks of four different weights. Two trucks of each weight will constitute the only traffic that will use one each of four separate and approximately equal parts of the test section for the duration of the test.

Two two-axle trucks, each with 18,000 pounds on the rear axle, are operated on one test section, and two two-axle trucks, each with 22,400 pounds on the rear axle, are being operated on a second test section. Two three-axle trucks, with 32,000 pounds equally divided between the tandem rear axles, and two three-axle trucks, with 44,800 pounds shared equally by the tandem axles, are being operated on the third and fourth sections, respectively.

The test highway has a two-lane, wire-mesh-reinforced concrete pavement, each 12-foot lane of which has a cross section 9 inches thick at the edges and 7 inches thick at the center. The pavement was constructed in 1941, and for 9 years has been subjected to the usual natural forces and to loadings of comparatively light weight. At the beginning of the test it was remarkably free of visible damage. Tests were made on numerous samples of subgrade soil and cores from the pavement to indicate their quality.

The recorded cracking of the four differently loaded test sections and other visible effects of the traffic on the pavement will be used as a measure of the effects of the several loads. Measurements of the strains produced in the pavement by loads of various magnitudes, of the deflection of the slabs under the test vehicles, of the subgrade condition, of the surface elevations, of the concrete quality, and of the surface riding qualities are being made.

Nonrigid pavements.—There is widespread interest in the development of more rational methods for the design of pavements of the nonrigid type. More than half of the States are now using some empirical method of design for the so-called "flexible" or nonrigid class of pavements. The Bureau has been continuously active in promoting this development. Working in cooperation with the Highway Research Board and the Asphalt Institute, a broad investigation of the structural action of nonrigid pavements was begun several years ago. The experimental work, centered at Hybla Valley, Va., has followed a comprehensive program of plate-loading tests on special sections of test pavement.

A portion of the program requires tests with heavy axle loads in motion. A special test vehicle has been obtained and the moving-load test program will be started shortly. Special equipment for measuring pavement deflections under moving loads has been obtained.

The results of the plate-load tests already completed are considered to be both informative and significant. It is indicated that the elastic action of the nonrigid pavement may provide the long-sought criterion for determining its load-carrying capacity. The data obtained are being analyzed and presented to a cooperative supervising committee in a series of progress reports that eventually will form the basis for a formal publication.

Bridges.—For some years a series of structural damping investigations have been under way to derive information for use in designing suspension bridges to resist strong winds. This work has been completed. The general report is contained in the paper *Structural Damping in Suspension Bridges*, now being considered for publication by the American Society of Civil Engineers. A more detailed account of the damping tests is planned for publication by the Bureau.

There has long been need for a study of the effects of moving vehicle loads on highway bridges. A pilot study was carried out on a highway bridge at Fort Loudon, Pa., in cooperation with the Pennsylvania Department of Highways and with the assistance of the American Association of Railroads through the loan of equipment and personnel for instrumental measurements. Since this pilot study, the Bureau has been assembling measuring instruments that will make possible a program of such studies carried out in cooperation with interested State highway organizations.

Other research.—The application of geophysical methods of subsurface exploration to highway engineering problems, pioneered by the Bureau, is attracting increasing attention, both among engineers from foreign countries visiting the United States and among engineers of the State highway departments and other agencies.

In Kansas a series of tests was made at the request of the State to determine the applicability of the methods to the location and identification of geologic formations typical of that region. In New Jersey the usefulness of the resistivity method is being studied in connection with construction of a highway across a marsh where special methods must be used to obtain firm support for the road surface. In West Virginia some study was made of the possibilities of the methods for exploring slide areas. In other locations explorations were made at sites of proposed tunnels and other structures.

During the last year the results of these studies were described in a general paper before the Highway Research Board and in papers of more limited scope published elsewhere.

Appendix

LIST OF TABLES

1. Summary of programs approved and work completed in the fiscal year 1950, by class of highway and by fund.
2. Projects under construction or plans approved on June 30, 1950, by class of highway and by fund.
3. Apportionment of Federal-aid highway funds authorized for the fiscal year ended June 30, 1951.
4. Status of plan preparation for future construction of Federal-aid and State highways, and highways in National forests and other Federal areas, as of April 1, 1950.
5. Projects financed with postwar Federal-aid funds programed during the fiscal year ended June 30, 1950, by State.
6. Projects involving Federal funds awarded to contract during the fiscal year ended June 30, 1950, by program and by State.
7. Status of projects as of June 30, 1950, and projects completed during the fiscal year.
8. Status of projects as of June 30, 1950, and projects completed during the fiscal year, on Federal-aid primary system in rural areas.
9. Status of projects as of June 30, 1950, and projects completed during the fiscal year, on secondary roads in rural areas.
10. Status of projects as of June 30, 1950, and projects completed during the fiscal year, in urban areas.
11. Interstate system improvements financed with postwar Federal-aid funds: Status of projects as of June 30, 1950, and projects completed during the fiscal year.
12. Federal funds paid by Bureau of Public Roads during the fiscal year ended June 30, 1950, by program and by State.
13. Balances of Federal funds available to States for projects not yet programed as of June 30, 1950.
14. Average number of persons employed on Bureau of Public Roads and State highway construction and maintenance, United States and Territories, by program and by month, for the fiscal year ended June 30, 1950.
15. Mileage of designated Federal-aid systems, by State, as of June 30, 1950.
16. Status of National forest highway projects as of June 30, 1950, and projects completed during the fiscal year.
17. Mileage of the National forest highway system, by forest road class and by State, as of June 30, 1950.
18. Mileage of highways in or leading to National parks, monuments, and parkways, by construction status and by area, as of June 30, 1950.
19. Mileage of approach roads to National parks and monuments, by construction status and by location, as of June 30, 1950.

Table 1.—*Summaries of programs approved and work completed in the fiscal year 1950, by class of highway and by fund*

	PROGRAMS APPROVED [1]						WORK COMPLETED					
				Railway-highway crossing improvements						Railway-highway crossing improvements		
	Total cost	Federal funds	Miles	Crossings eliminated	Structures reconstructed	Crossings protected	Total cost	Federal funds	Miles	Crossings eliminated	Structures reconstructed	Crossings protected
	BY CLASS OF HIGHWAY						BY CLASS OF HIGHWAY					
Primary	$449, 968, 218	$227, 768, 941	7, 121. 6	78	15	109	$371, 699, 122	$196, 037, 485	5, 914. 3	63	26	103
Secondary rural	304, 614, 092	155. 304, 564	18, 084. 9	18	7	206	255, 018, 251	129, 237, 080	13, 514. 7	21	8	256
Urban	297, 697, 647	143. 779, 068	636. 5	56	4	24	241, 105, 272	124, 540, 879	778. 9	69	14	55
Subtotal	1, 052, 279, 957	526, 852, 573	25, 843. 0	152	26	339	867, 822, 645	449, 815, 444	20. 207. 9	153	48	414
Not classified [2]	32. 451, 164	29, 824, 814	816. 0				37, 724, 695	31, 114, 750	822. 5	1		
Total	1, 084, 731, 121	556, 677, 387	26, 659. 0	152	26	339	905, 547, 340	480, 930, 194	21, 030. 4	154	48	414
	BY FUND						BY FUND					
Postwar Federal-aid:												
Primary	$476, 741, 277	$240, 973, 034	7, 349. 1	80	15	110	$389, 492, 899	$200, 012, 906	6, 158. 7	51	19	89
Secondary	306, 380, 078	155, 912, 524	18, 053. 4	16	7	179	243, 812, 925	122, 465, 162	13, 215. 0	16	7	156
Urban	265, 661, 350	127, 683, 398	366. 2	48	4	12	182, 068, 290	92, 897, 115	295. 1	59	8	11
Prewar Federal-aid:												
Primary	531, 875	268, 111	6. 8				16, 857, 864	9, 096, 316	190. 4	1		
Secondary	445, 967	347, 790	29. 8				10, 252, 000	4, 520, 337	303. 1			
Grade crossing	2, 519. 410	1. 667, 716	37. 7	8		38	11, 693, 595	10, 789, 724	19. 2	24	12	158
Emergency highway and grade-crossing							623, 853	592, 704	. 8	2	2	
Defense Highway Act							13, 021, 219	9, 441, 180	25. 6			
Subtotal	1, 052, 279, 957	526, 852, 573	25, 843. 0	152	26	339	867, 822, 645	449, 815, 444	20, 207. 9	153	48	414
National forest highway [3]	22, 117, 219	20, 513, 859	536. 2				20, 181, 365	19, 097, 533	541. 4			
National park and parkway [4]	8, 143, 114	8, 143, 114	255. 4				5, 123, 963	5, 123, 963	170. 0			
Public lands	39, 883	36, 283	1. 5				1, 419, 528	1, 234, 104	44. 7			
Emergency flood relief	2, 150, 948	1, 131, 558	22. 9				10, 999, 839	5, 659, 150	66. 4	1		
Subtotal	32, 451, 164	29, 824, 814	816. 0				37, 724, 695	31, 114, 750	822. 5	1		
Total	1, 084, 731, 121	556, 677, 387	26, 659. 0	152	26	339	905, 547, 340	480, 930, 194	21, 030. 4	154	48	414

---

[1] Initial commitment of funds.

[2] Forest, park, public lands, and emergency flood-relief projects.

[3] Includes construction projects only.

[4] Construction supervised by Bureau of Public Roads.

Table 2.—*Projects under construction or plans approved on June 30, 1950, by class of highway and by fund*

	Total cost	Federal funds	Miles	Railway-highway crossing improvements		
				Crossings eliminated	Structures reconstructed	Crossings protected
BY CLASS OF HIGHWAY						
Primary	$498, 409, 735	$255, 268, 660	6, 547. 7	81	31	68
Secondary rural	305, 384, 880	155, 835, 452	14, 299. 4	19	14	195
Urban	520, 673, 828	251, 661, 147	841. 6	131	21	79
Subtotal	1, 324, 468, 443	662, 765, 259	21, 688. 7	231	66	342
Not classified [1]	57, 725, 989	51, 167, 046	1, 187. 9	1		
Total	1, 382, 194, 432	713, 932, 305	22, 876. 6	232	66	342
BY FUND						
Postwar Federal-aid:						
Primary	$538, 026, 102	$271, 925, 201	6, 930. 2	86	31	85
Secondary	298, 826, 424	150, 521, 360	14, 208. 7	17	16	153
Urban	428, 700, 157	203, 978, 759	375. 2	104	10	7
Prewar Federal-aid:						
Primary	12, 044, 374	6, 055, 747	33. 6			
Secondary	7, 296, 719	3, 834, 048	84. 9			
Grade crossing	18, 785, 058	13, 925, 072	43. 8	22	9	97
Emergency highway and grade crossing	702, 535	702, 535		2		
Defense Highway Act	20, 087, 074	11, 822, 537	12. 3			
Subtotal	1, 324, 468, 443	662, 765, 259	21, 688. 7	231	66	342
National forest highway [2]	36, 811, 828	34, 359, 132	840. 8			
National park and parkway [3]	12, 231, 073	12, 231, 073	277. 6			
Public lands	633, 615	531, 404	11. 4			
Emergency flood relief	8, 049, 473	4, 045, 437	58. 1	1		
Subtotal	57, 725, 989	51, 167, 046	1, 187. 9	1		
Total	1, 382, 194, 432	713, 932, 305	22, 876. 6	232	66	342

[1] Forest, park, public lands, and emergency flood relief projects.
[2] Includes construction projects only.
[3] Construction supervised by Bureau of Public Roads.

Table 3.—*Apportionment of Federal-aid highway funds authorized for the fiscal year ended June 30, 1951* [1]

State or territory	Federal-aid highway system	Secondary or feeder roads	Urban highways	Total
Alabama	$4, 263, 373	$3, 367, 109	$1, 157, 921	$8, 788, 403
Arizona	2, 884, 918	1, 995, 026	232, 926	5, 112, 870
Arkansas	3, 440, 900	2, 767, 936	495, 958	6, 704, 794
California	8, 037, 278	4, 602, 788	7, 216, 292	19, 856, 358
Colorado	3, 575, 649	2, 406, 251	829, 510	6, 811, 410
Connecticut	1, 242, 466	682, 562	2, 316, 659	4, 241, 687
Delaware	974, 531	649, 688	181, 297	1, 805, 516
Florida	2, 904, 565	1, 945, 506	1, 421, 220	6, 271, 291
Georgia	5, 017, 556	3, 828, 985	1, 441, 091	10, 287, 632
Idaho	2, 471, 847	1, 728, 865	188, 176	4, 388, 888
Illinois	7, 798, 916	4, 189, 809	8, 449, 887	20, 438, 612
Indiana	4, 741, 346	3, 179, 477	2, 723, 787	10, 644, 610
Iowa	4, 913, 437	3, 513, 955	1, 414, 525	9, 841, 917
Kansas	4, 956, 553	3, 481 866	983, 721	9, 422, 140
Kentucky	3, 772, 305	3, 050, 595	1, 154, 581	7, 977, 481
Louisiana	3, 052, 605	2, 281, 103	1, 360, 748	6, 694, 456
Maine	1, 717, 684	1, 238, 176	498, 017	3, 453, 877
Maryland	1, 635, 712	1, 045, 942	1, 590, 418	4, 272, 072
Massachusetts	2, 619, 300	702, 068	5, 875, 054	9, 196, 422
Michigan	6, 057, 777	3, 663, 373	5, 048, 623	14, 769. 773
Minnesota	5, 345, 224	3, 682, 804	1, 960, 081	10, 988, 109
Mississippi	3, 672, 990	3, 016, 921	533, 179	7, 223, 090
Missouri	5, 910, 889	4, 049, 345	2, 799, 683	12, 759, 917
Montana	4, 051, 448	2, 767, 823	273, 348	7, 092, 619
Nebraska	3, 944, 850	2, 785, 550	695, 466	7, 425, 866
Nevada	2, 562, 973	1, 717, 361	53, 853	4, 334, 187
New Hampshire	974, 531	649, 688	422, 019	2, 046, 238
New Jersey	2, 547, 926	927, 560	4, 911, 404	8, 386, 890
New Mexico	3, 231, 155	2, 236, 700	228, 567	5, 696, 422
New York	9, 621, 543	3, 792, 806	16, 681, 818	30, 096, 167
North Carolina	4, 877, 462	3, 990, 309	1, 326, 007	10, 193, 778
North Dakota	2, 948, 287	2, 125, 686	190, 644	5, 264, 617
Ohio	6, 940, 178	4, 083, 099	6, 698, 622	17, 721, 899
Oklahoma	4, 490, 377	3, 298, 766	1, 197, 791	8, 986, 934
Oregon	3, 325, 613	2, 269, 150	720, 430	6, 315, 193
Pennsylvania	8, 151, 917	4, 676, 549	9, 344, 128	22, 172, 594
Rhode Island	974, 531	649, 688	997, 786	2, 622, 005
South Carolina	2, 720, 661	2, 244, 168	581, 082	5, 545, 911
South Dakota	3, 109, 459	2, 214, 296	197, 342	5, 521, 097
Tennessee	4, 271, 311	3, 282, 043	1, 415, 352	8, 968, 706
Texas	12, 683, 893	8, 933, 674	3, 966, 153	25, 583, 720
Utah	2, 265, 127	1, 508, 492	385, 353	4, 158, 972
Vermont	974, 531	649, 688	188, 251	1, 812, 470
Virginia	3, 671, 363	2, 846, 104	1, 324, 938	7, 842, 405
Washington	3, 142, 071	2, 127, 490	1, 303, 754	6, 573, 315
West Virginia	2, 212, 327	1, 857, 719	717, 603	4. 787, 649
Wisconsin	4, 792, 360	3, 246, 382	2, 358, 393	10, 397, 135
Wyoming	2, 470, 864	1, 676, 874	118, 209	4, 265, 947
District of Columbia	974, 531	649, 688	1, 018, 601	2, 642, 820
Hawaii	974, 531	649, 688	349, 535	1, 973, 754
Puerto Rico	992, 609	1, 010, 309	741, 447	2, 744, 365
Total	194, 906, 250	129, 937, 500	108, 281, 250	433, 125, 000

[1] Funds apportioned September 8, 1949.

Table 4.—*Status of plan preparation for future construction of Federal-aid and State highways, and highways in National forests and other Federal areas as of April 1, 1950*

State	Plans under way		Plans completed		Total	
	Construction cost	Miles	Construction cost	Miles	Construction cost	Miles
	1,000 dollars		*1,000 dollars*		*1,000 dollars*	
Alabama	25, 886	742	3, 383	94	29, 269	836
Arizona	17, 593	286	2, 268	52	19, 861	338
Arkansas	21, 667	613	14, 121	355	35, 788	968
California	570, 279	2, 287	70, 571	753	640, 850	3, 040
Colorado	23, 413	1, 022	5, 877	227	29, 290	1, 249
Connecticut	30, 000	117	1, 050	3	31, 050	120
Delaware	14, 870	155	1, 954	16	16, 824	171
Florida	12, 500	500	2, 000	50	14, 500	550
Georgia	72, 140	3, 029	22, 430	459	94, 570	3, 488
Idaho	33, 870	579	14, 573	379	48, 443	958
Illinois	130, 012	1, 231	34, 111	593	164, 123	1, 824
Indiana	99, 578	909	19, 504	204	119, 082	1, 113
Iowa	50, 000	1, 500	11, 408	833	61, 408	2, 333
Kansas	15, 209	1, 186	7, 113	415	22, 322	1, 601
Kentucky	25, 447	747	31, 975	962	57, 422	1, 709
Louisiana	26, 741	332	23, 206	364	49, 947	696
Maine	13, 042	139	9, 141	120	22, 183	259
Maryland	27, 546	143	21, 012	138	48, 558	281
Massachusetts	52, 811	51	12, 893	40	65, 704	91
Michigan	62, 000	650	21, 000	300	83, 000	950
Minnesota	34, 057	875	21, 580	898	55, 637	1, 773
Mississippi	32, 564	676	7, 261	130	39, 825	806
Missouri	30, 729	606	16, 222	441	46, 951	1, 047
Montana	20, 519	641	4, 695	94	25, 214	735
Nebraska	28, 602	923	2, 257	65	30, 859	988
Nevada	16, 166	523	7, 711	312	23, 877	835
New Hampshire	4, 871	52	2, 328	15	7, 199	67
New Jersey	112, 931	125	70, 259	88	183, 190	213
New Mexico	24, 498	664	4, 897	118	29, 395	782
New York	400, 000	1, 270	165, 000	385	565, 000	1, 655
North Carolina	40, 419	565	7, 630	232	48, 049	797
North Dakota	7, 557	346	7, 398	470	14, 955	816
Ohio	121, 237	647	13, 387	148	134, 624	795
Oklahoma	23, 456	494	11, 392	358	34, 848	852
Oregon	14, 423	258	4, 466	77	18, 889	335
Pennsylvania	221, 234	1, 004	163, 323	1, 097	384, 557	2, 101
Rhode Island	11, 858	59	2, 872	7	14, 730	66
South Carolina	18, 000	600	5, 000	200	23, 000	800
South Dakota	17, 901	868	13, 335	1, 250	31, 236	2, 118
Tennessee	33, 181	396	4, 920	211	38, 101	607
Texas	49, 102	2, 699	17, 408	1, 054	66, 510	3, 753
Utah	23, 935	521	5, 416	175	29, 351	696
Vermont	6, 800	97	1, 235	17	8, 035	114
Virginia	54, 295	923	26, 765	537	81, 060	1, 460
Washington	160, 464	1, 676	5, 365	170	165, 829	1, 846
West Virginia	7, 758	145	2, 363	58	10, 121	203
Wisconsin	48, 195	963	15, 137	436	63, 332	1, 399
Wyoming	34, 134	852	6, 793	250	40, 927	1, 102
Alaska	5, 722	38	989	8	6, 711	46
District of Columbia	12, 193	18	11, 717	5	23, 910	23
Hawaii	11, 176	47	4, 525	10	15, 701	57
Puerto Rico	9, 785	63	1, 490	9	11, 275	72
Virgin Islands	----------	----------	168	9	168	9
Total	2, 962, 366	35, 852	964, 894	15, 691	3, 927, 260	51, 543

Table 5.—*Projects financed with postwar Federal-aid funds programed[1] during the fiscal year ended June 30, 1950, by State*

State or Territory	Primary			Secondary			Urban			Total		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$7, 796, 982	$3, 940, 037	135. 3	$9, 261, 841	$4, 462, 872	615. 9				$17, 058, 823	$8, 402, 909	751. 2
Arizona	4, 741, 534	3, 409, 205	88. 0	3, 019, 013	2, 111, 895	122. 4	$490, 000	$351, 134	3. 1	8, 250, 547	5, 872, 234	213. 5
Arkansas	14, 977, 800	7, 698, 299	272. 7	7, 368, 621	3, 662, 422	317. 7	1, 893, 388	1, 210, 964	7. 8	24, 239, 809	12, 571, 685	598. 2
California	27, 083, 400	10, 208, 845	129. 2	12, 751, 565	5, 885, 128	264. 4	15, 412, 000	7, 108, 048	7. 0	55, 246, 965	23, 202, 021	400. 6
Colorado	7, 628, 573	4, 155, 433	140. 2	4, 271, 900	2, 401, 718	245. 3	2, 463, 662	1, 329, 257	6. 5	14, 364, 135	7, 886, 408	392. 0
Connecticut	1, 690, 155	966, 318	2. 9	731, 909	362, 938	3. 7	7, 440, 650	3, 849, 481	16. 5	9, 862, 714	5, 178, 737	23. 1
Delaware	3, 825, 852	1, 914, 087	13. 4	3, 045, 938	1, 492, 937	74. 9	6, 060	2, 758		6, 877, 850	3, 409, 782	88. 3
Florida	11, 421, 567	6, 210, 784	245. 1	4, 667, 162	2, 057, 428	278. 5	2, 854, 401	1, 652, 321	11. 5	18, 943, 130	9, 920, 533	535. 1
Georgia	12, 932, 960	6, 675, 665	208. 2	14, 862, 408	7, 540, 652	852. 0	2, 356, 464	1, 129, 232	6. 6	30, 151, 832	15, 345, 549	1, 066. 8
Idaho	4, 892, 051	3, 058, 538	130. 6	2, 702, 666	1, 689, 113	176. 3	304, 922	190, 850	1. 5	7, 899, 639	4, 938, 501	308. 4
Illinois	12, 894, 541	6, 644, 453	176. 9	2, 958, 245	1, 478, 150	99. 2	17, 404, 508	8, 604, 622	27. 9	33, 257, 294	16, 727, 225	304. 0
Indiana	8, 206, 163	4, 119, 657	35. 8	2, 648, 142	1, 288, 389	39. 6	78, 200	44, 025		10, 932, 505	5, 452, 071	75. 4
Iowa	13, 153, 267	4, 926, 734	410. 7	7, 616, 828	3, 797, 837	680. 1	1, 584, 605	741, 786	6. 2	22, 354, 700	9, 466, 357	1, 097. 0
Kansas	10, 836, 263	5, 395, 541	305. 0	5, 164, 913	2, 572, 376	1, 194. 1	2, 843, 831	1, 543, 204	7. 0	18, 845, 007	9, 511, 121	1, 506. 1
Kentucky	11, 628, 434	5, 785, 015	171. 6	7, 057, 491	3, 528, 745	216. 4	3, 686, 388	1, 704, 694	12. 9	22, 372, 313	11, 018, 454	400. 9
Louisiana	10, 803, 061	5, 440, 084	132. 6	1, 506, 172	752, 636	33. 0	614, 642	307, 321	1. 9	12, 923, 875	6, 500, 041	167. 5
Maine	6, 812, 880	3, 568, 143	68. 0	3, 059, 042	1, 521, 521	74. 4	458, 120	229, 060	1. 8	10, 330, 042	5, 318, 724	144. 2
Maryland	3, 526, 070	1, 545, 212	4. 4	2, 064, 367	977, 350	74. 8	5, 305, 712	2, 475, 986	5. 6	10, 896, 149	4, 998, 548	84. 8
Massachusetts	4, 820, 599	2, 636, 175	11. 4	3, 190, 915	1, 593, 367	20. 9	20, 086, 547	9, 091, 159	20. 5	28, 098, 061	13, 320, 701	52. 8
Michigan	8, 947, 850	4, 801, 225	163. 5	8, 548, 121	4, 291, 853	547. 1	7, 504, 830	3, 752, 415	5. 0	25, 000, 801	12, 845, 493	715. 6
Minnesota	12, 152, 047	5, 884, 429	404. 2	8, 659, 731	4, 361, 439	1, 554. 7	1, 458, 710	663, 932	7. 3	22, 270, 488	10, 909, 800	1, 966. 2
Mississippi	2, 866, 400	1, 432, 400	116. 8	6, 525, 065	3, 235, 182	337. 5	553, 400	276, 700	4. 9	9, 944, 865	4, 944, 282	459. 2
Missouri	11, 299, 474	5, 558, 104	164. 9	7, 367, 159	3, 780, 908	724. 3	7, 546, 810	3, 753, 095	3. 1	26, 213, 443	13, 092, 107	892. 3
Montana	16, 220, 051	9, 055, 268	440. 3	5, 598, 385	3, 196, 991	378. 5				21, 818, 436	12, 252, 259	818. 8
Nebraska	6, 665, 172	3, 380, 849	201. 8	5, 686, 541	3, 056, 199	204. 6	1, 580, 028	703, 825	2. 4	13, 931, 741	7, 140, 873	408. 8
Nevada	5, 538, 989	4, 552, 659	133. 1	2, 485, 599	2, 055, 336	149. 5	66, 204	54, 618	. 3	8, 090, 792	6, 662, 613	282. 9
New Hampshire	2, 257, 774	1, 108, 299	19. 4	1, 719, 029	852, 203	20. 3	108, 660	52, 330	. 4	4, 085, 463	2, 012, 832	40. 1
New Jersey	6, 805, 693	3, 362, 628	19. 0	875, 419	436, 997	8. 2	10, 587, 694	5, 201, 356	12. 3	18, 268, 806	9, 000, 981	39. 5
New Mexico	7, 278, 729	4, 716, 609	123. 2	6, 315, 055	4, 029, 002	360. 7	458, 041	292, 230	3. 2	14, 051, 825	9, 037, 841	487. 1
New York	22, 770, 124	10, 249, 878	101. 0	3, 228, 074	1, 909, 135	29. 8	41, 770, 093	20, 322, 881	52. 1	67, 768, 291	32, 481, 894	182. 9
North Carolina	22, 123, 943	10, 564, 258	478. 0	13, 369, 611	6, 612, 035	678. 0	4, 014, 136	1, 868, 380	24. 3	39, 507, 690	19, 044, 673	1, 180. 3
North Dakota	5, 702, 661	2, 843, 162	224. 3	6, 353, 522	3, 138, 515	974. 4	6, 436	3, 218		12, 062, 619	5, 984, 895	1, 198. 7

Ohio	27, 696, 533	13, 743, 512	159. 0	11, 571, 390	5, 995, 789	358. 3	32, 580, 229	14, 875, 944	23. 3	71, 848, 152	34, 615, 245	540. 6
Oklahoma	12, 049, 615	6, 254, 716	199. 4	12, 293, 790	4, 994, 555	357. 7	4, 248, 300	2, 395, 718	9. 2	28, 591, 705	13, 644, 989	566. 3
Oregon	5, 921, 908	3, 478, 284	86. 9	6, 144, 099	3, 618, 037	172. 6	2, 279, 868	1, 210, 806	1. 5	14, 345, 875	8, 307, 127	261. 0
Pennsylvania	18, 951, 840	9, 449, 553	52. 5	13, 192, 496	6, 596, 248	119. 7	34, 411, 053	16, 782, 125	19. 3	66, 555, 389	32, 827, 926	191. 5
Rhode Island	1, 100, 014	547, 157	2. 9	3, 944, 575	1, 960, 122	46. 6	3, 283, 632	1, 493, 866	2. 3	8, 328, 221	4, 001, 145	51. 8
South Carolina	6, 811, 961	3, 615, 519	89. 5	7, 991, 676	3, 963, 514	737. 6	2, 793, 152	1, 369, 925	9. 9	17, 596, 789	8, 948, 958	837. 0
South Dakota	6, 273, 797	3, 698, 881	403. 0	5, 699, 063	3, 290, 484	703. 7	90, 327	50, 735	1. 2	12, 063, 187	7, 040, 100	1, 107. 9
Tennessee	12, 592, 964	5, 827, 936	105. 0	8, 355, 852	3, 998, 195	582. 6	6, 534, 920	2, 992, 460	3. 5	27, 483, 736	12, 818, 591	691. 1
Texas	11, 972, 027	6, 203, 760	191. 4	25, 398, 282	12, 674, 525	2, 338. 6	4, 084, 100	2, 016, 350	3. 4	41, 454, 409	20, 894, 635	2, 533. 4
Utah	3, 192, 547	2, 326, 688	82. 6	1, 496, 558	1, 088, 228	65. 6	605, 940	437, 807	6. 9	5, 295, 045	3, 852, 723	155. 1
Vermont	2, 612, 981	1, 257, 851	8. 6	1, 136, 601	562, 663	3. 8	247, 566	123, 783	1. 7	3, 997, 148	1, 944, 297	14. 1
Virginia	17, 929, 186	8, 999, 828	188. 8	10, 757, 105	5, 299, 069	471. 5	2, 020, 959	892, 752	6. 7	30, 707, 250	15, 191, 649	667. 0
Washington	6, 964, 408	2, 971, 831	62. 6	6, 795, 180	2, 971, 329	157. 2				13, 759, 588	5, 943, 160	219. 8
West Virginia	5, 213, 034	2, 373, 184	31. 9	5, 771, 790	2, 959, 502	140. 2	3, 630, 700	800, 644	. 5	14, 615, 524	6, 133, 330	172. 6
Wisconsin	16, 547, 872	8, 533, 285	280. 7	4, 116, 985	1, 922, 845	253. 5	3, 784, 457	2, 013, 541	10. 1	24, 449, 314	12, 469, 671	544. 3
Wyoming	4, 790, 608	3, 015, 733	106. 4	2, 795, 113	1, 826, 137	174. 7	2, 729	1, 773		7, 588, 450	4, 843, 643	281. 1
District of Columbia	758, 634	379, 317	2. 3	1, 690, 339	845, 145	5. 3	30, 998	15, 499		2, 479, 971	1, 239, 961	7. 6
Hawaii	4, 926, 139	2, 420, 931	24. 1	2, 213, 060	1, 045, 030	12. 5	2, 527, 366	1, 083, 743	1. 8	9, 666, 565	4, 549, 704	38. 4
Puerto Rico	134, 150	67, 075		335, 675	167, 838	. 5	1, 565, 912	615, 045	5. 3	2, 035, 737	849, 958	5. 8
Total	476, 741, 277	240, 973, 034	7, 349. 1	306, 380, 078	155, 912, 524	18, 053. 4	265, 661, 350	127, 683, 398	366. 2	1,048,782,705	524, 568, 956	25, 768. 7

---

[1] Initial commitment of funds.

Table 6.—*Projects involving Federal funds awarded to contract during the fiscal year [1] ended June 30, 1950, by program and by State*

State or Territory	Total cost	Total Federal funds	Postwar Federal-aid funds			Prewar Federal-aid funds			Other	Miles
			Primary [2]	Secondary	Urban	Primary	Secondary	Grade crossing		
Alabama	$12, 650, 249	$6, 758, 445	$2, 637, 814	$2, 783, 671	$1, 210, 950	$80		$125, 930		558.0
Arizona	7, 808, 904	5, 532, 330	3, 231, 686	2, 300, 644						183.8
Arkansas	16, 133, 909	7, 632, 850	3, 945, 621	2, 282, 121	1, 405, 108					374.5
California	29, 196, 339	14, 354, 253	8, 681, 865	3, 316, 288	2, 356, 100					267.0
Colorado	12, 397, 860	7, 183, 221	3, 596, 508	2, 987, 804	598, 909					449.4
Connecticut	8, 531, 660	4, 562, 612	526, 900	450, 767	3, 584, 945					22.5
Delaware	6, 628, 191	3, 188, 600	2, 088, 497	1, 100, 103						66.1
Florida	11, 663, 929	6, 120, 820	3, 656, 210	2, 457, 410				7, 200		339.0
Georgia	19, 152, 546	9, 776, 552	4, 016, 576	5, 335, 450	189, 218	184, 855		50, 453		721.3
Idaho	5, 074, 608	3, 193, 424	2, 052, 984	1, 140, 440						194.9
Illinois	40, 116, 923	20, 025, 515	8, 406, 106	1, 929, 709	9, 686, 537			3, 163		435.6
Indiana	9, 837, 971	5, 211, 955	2, 111, 863	1, 646, 887	1, 453, 205					64.8
Iowa	26, 926, 210	13, 055, 608	7, 347, 543	3, 782, 522	1, 925, 543					1, 095.3
Kansas	18, 247, 314	9, 197, 487	5, 454, 059	2, 885, 491	522, 052	335, 885				1, 651.6
Kentucky	17, 562, 860	8, 852, 906	4, 231, 883	3, 853, 779	767, 244					367.7
Louisiana	12, 157, 364	6, 183, 140	1, 879, 226	3, 002, 805	824, 400			476, 709		177.3
Maine	5, 318, 827	2, 771, 423	1, 158, 758	1, 513, 655	99, 010					83.3
Maryland	6, 402, 860	2, 979, 753	1, 659, 646	626, 107	623, 756			70, 244		66.8
Massachusetts	39, 575, 406	19, 703, 576	2, 913, 037	1, 338, 993	15, 283, 086		$4, 552	163, 908		92.4
Michigan	21, 692, 382	10, 807, 532	3, 755, 100	2, 724, 592	4, 327, 840					448.6
Minnesota	19, 372, 875	10, 502, 768	5, 305, 088	2, 694, 286	2, 413, 713		87, 618	2, 063		1, 303.2
Mississippi	4, 727, 814	2, 369, 389	482, 733	1, 310, 566	576, 090					198.7
Missouri	21, 070, 106	10, 740, 935	7, 115, 516	2, 737, 444	887, 975					788.5
Montana	11, 129, 850	6, 835, 206	4, 273, 514	1, 770, 869	733, 130			57, 693		454.9
Nebraska	12, 353, 214	6, 682, 113	3, 798, 792	1, 930, 740	197, 912	262, 681	31, 032	460, 956		355.2
Nevada	5, 532, 980	4, 540, 800	2, 464, 191	2, 017, 072	53, 811		5, 726			213.7
New Hampshire	2, 992, 995	1, 481, 571	847, 065	541, 232	93, 274					33.0
New Jersey	14, 889, 471	6, 751, 853	1, 368, 490	609, 929	4, 288, 100			485, 334		32.4
New Mexico	11, 658, 787	7, 560, 751	4, 117, 041	3, 013, 803	278, 237		14, 320	137, 350		441.1
New York	47, 525, 171	24, 035, 430	7, 578, 043	2, 146, 368	13, 627, 018			684, 001		146.8
North Carolina	17, 506, 877	8, 613, 449	2, 771, 784	3, 768, 545	2, 073, 120					568.5
North Dakota	13, 124, 463	6, 622, 755	4, 045, 596	1, 989, 804	92, 815		344, 800	149, 740		1, 165.5

Ohio	27, 357, 442	14, 047, 419	8, 232, 912	3, 221, 297	2, 593, 210					223. 6
Oklahoma	30, 635, 624	14, 946, 884	6, 745, 087	6, 416, 179	1, 515, 630	63, 407	160, 220	46, 361		1, 096. 5
Oregon	10, 785, 125	6, 301, 105	3, 478, 105	1, 933, 000	890, 000					211. 9
Pennsylvania	48, 398, 235	24, 336, 621	9, 631, 635	5, 373, 803	9, 331, 183					195. 3
Rhode Island	1, 973, 635	1, 045, 754	838, 460	207, 294						12. 1
South Carolina	10, 373, 986	5, 379, 616	1, 115, 065	3, 253, 061	1, 011, 490					632. 6
South Dakota	9, 566, 766	6, 015, 580	2, 316, 406	2, 027, 596	266, 128		727, 762	677, 688		921. 5
Tennessee	16, 301, 359	8, 134, 065	4, 280, 375	3, 853, 690						591. 2
Texas	52, 026, 531	23, 520, 484	9, 882, 400	12, 353, 323	1, 200, 500			84, 261		2, 548. 0
Utah	5, 388, 684	3, 983, 430	2, 379, 277	1, 297, 539	297, 633			8, 981		203. 3
Vermont	3, 087, 465	1, 395, 989	1, 062, 797	333, 192						33. 8
Virginia	13, 055, 538	6, 394, 251	2, 508, 263	3, 059, 189	688, 160			58, 639	$80, 000	395. 7
Washington	15, 064, 191	6, 544, 089	3, 015, 500	2, 403, 489	1, 125, 100					178. 8
West Virginia	7, 402, 664	3, 715, 488	1, 751, 774	1, 815, 310	146, 240			2, 164		93. 9
Wisconsin	17, 388, 537	8, 618, 378	3, 953, 700	2, 902, 338	1, 298, 340			464, 000		657. 4
Wyoming	7, 547, 894	4, 985, 677	2, 728, 419	2, 092, 473	156, 687			8, 098		375. 1
District of Columbia	1, 107, 558	525, 388	525, 388							1. 9
Hawaii	4, 383, 268	2, 251, 252	1, 510, 278	29, 748	195, 975	333, 527	181, 724			28. 4
Puerto Rico	6, 377, 856	3, 023, 048	1, 868, 654	775, 296	378, 502	596				36. 7
Total	797, 183, 273	408, 993, 540	185, 344, 230	125, 337, 713	91, 267, 876	1, 181, 031	1, 557, 754	4, 224, 936	80, 000	21, 799. 1

---

[1] Includes force account projects placed under construction during the fiscal year.
[2] Funds available for either rural or urban portions of the Federal-aid highway system.

Table 7.—*Status of projects as of June 30, 1950, and projects completed during the fiscal year* [1]

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$14, 192, 469	$7, 145, 143	419. 7	$4, 814, 391	$2, 342, 610	156. 7	$12, 553, 397	$6, 503, 892	269. 1	$10, 379, 706	$5, 728, 050	503. 5
Arizona	4, 146, 668	2, 907, 079	91. 5	1, 389, 711	971, 037	32. 9	6, 075, 555	4, 344, 843	116. 1	8, 232, 880	5, 505, 210	110. 5
Arkansas	11, 111, 683	6, 217, 385	287. 9	10, 767, 543	5, 285, 258	305. 1	14, 368, 750	7, 073, 696	323. 6	13, 087, 808	7, 114, 800	164. 7
California	36, 484, 165	14, 442, 482	238. 9	8, 498, 426	3, 806, 163	86. 3	38, 682, 955	19, 170, 760	217. 6	41, 037, 197	20, 135, 458	290. 1
Colorado	6, 602, 887	3, 106, 932	128. 7	2, 919, 405	1, 716, 077	96. 3	15, 882, 976	9, 173, 466	300. 9	13, 381, 012	7, 562, 547	335. 9
Connecticut	10, 434, 206	5, 049, 603	25. 3	2, 023, 856	981, 546	7. 1	6, 563, 877	3, 797, 390	8. 3	10, 780, 059	5, 533, 773	25. 0
Delaware	2, 642, 202	1, 329, 561	40. 5	2, 374, 479	1, 184, 520	15. 6	5, 029, 720	2, 387, 077	58. 5	3, 615, 996	2, 339, 133	31. 5
Florida	16, 165, 324	8, 245, 310	451. 7	6, 178, 991	3, 431, 221	126. 9	10, 657, 663	5, 405, 542	267. 2	7, 394, 921	3, 309, 156	167. 5
Georgia	15, 902, 650	8, 259, 185	417. 6	6, 425, 290	3, 212, 193	191. 0	42, 209, 133	20, 438, 923	731. 9	24, 004, 617	12, 100, 726	739. 7
Idaho	8, 919, 500	5, 595, 375	340. 7	1, 793, 318	1, 106, 826	46. 2	6, 804, 289	4, 250, 578	179. 6	3, 753, 063	2, 326, 649	132. 8
Illinois	46, 641, 776	24, 814, 486	367. 4	20, 409, 412	10, 183, 657	166. 7	49, 386, 627	23, 759, 216	353. 7	37, 085, 926	19, 059, 152	600. 9
Indiana	17, 986, 366	9, 493, 286	66. 9	7, 523, 837	3, 776, 606	64. 1	13, 249, 931	6, 910, 030	55. 9	18, 276, 184	9, 457, 051	143. 3
Iowa	13, 396, 683	5, 957, 476	607. 1	6, 834, 107	2, 654, 171	351. 8	21, 094, 066	10, 246, 851	758. 9	25, 117, 717	12, 911, 149	1, 017. 5
Kansas	11, 784, 722	6, 035, 408	1, 149. 1	4, 894, 689	2, 477, 576	484. 2	15, 056, 795	7, 736, 058	594. 5	25, 883, 838	12, 945, 938	2, 081. 1
Kentucky	14, 762, 784	7, 240, 892	200. 7	9, 330, 349	4, 637, 962	168. 7	15, 237, 634	7, 517, 639	289. 2	14, 728, 933	7, 563, 687	218. 6
Louisiana	19, 949, 532	9, 665, 201	211. 9	8, 387, 452	4, 105, 524	110. 2	16, 881, 065	8, 710, 191	183. 5	16, 141, 633	7, 564, 993	150. 1
Maine	9, 961, 673	5, 359, 065	127. 7	1, 276, 828	715, 001	9. 5	6, 003, 468	2, 976, 347	80. 6	5, 683, 127	2, 807, 946	65. 8
Maryland	7, 576, 860	3, 655. 737	29. 0	2, 921, 166	1, 198, 547	27. 3	17, 989, 134	9, 109, 871	68. 0	10, 963, 403	5, 888, 481	79. 9
Massachusetts	14, 576, 500	6, 710, 436	15. 5	6, 215, 621	3, 177, 658	7. 4	58, 302, 726	28, 236, 052	58. 7	11, 528, 050	6, 248, 703	78. 9
Michigan	17, 458, 616	9, 032, 358	599. 6	9, 526, 323	4, 754, 241	264. 0	44, 719, 555	18, 054, 402	203. 6	27, 806, 462	13, 663, 808	536. 4
Minnesota	12, 049, 168	6, 355, 964	1, 124. 3	11, 154, 448	5, 796, 409	761. 7	20, 442, 689	10, 754, 062	513. 0	22, 308, 455	11, 208, 367	938. 0
Mississippi	5, 824, 350	2, 923, 975	301. 2	2, 870, 600	1, 436, 150	130. 3	6, 534, 766	3, 424, 633	196. 9	17, 667, 583	8, 837, 762	473. 4
Missouri	29, 740, 118	15, 733, 231	848. 4	11, 410, 347	5, 054, 905	279. 5	31, 028, 528	15, 470, 632	605. 8	24, 430, 962	12, 439, 108	852. 5
Montana	16, 391, 872	8, 565, 343	610. 7	4, 054, 916	2, 502, 084	148. 9	14, 735, 791	9, 106, 517	374. 2	10, 045, 295	5, 789, 456	360. 5
Nebraska	19, 133, 506	9, 914, 264	664. 2	4, 132, 082	1, 944, 668	74. 7	13, 163, 499	7, 529, 132	310. 1	10, 887, 164	5, 451, 137	416. 9
Nevada	5, 474, 145	4, 514, 081	190. 1	220, 522	180, 094	3. 2	5, 482, 616	4, 493, 210	188. 4	4, 860, 468	3, 913, 165	183. 9
New Hampshire	5, 947, 887	2, 960, 765	58. 5	524, 414	242, 110	2. 9	3, 821, 968	1, 847, 493	27. 9	3, 504, 822	2, 065, 558	22. 5
New Jersey	4, 504, 357	2, 152, 389	11. 5	9, 878, 699	4, 819, 465	12. 3	17, 520, 592	8, 413, 357	26. 7	29, 917, 651	14, 518, 189	47. 7
New Mexico	9, 819, 001	6, 264, 418	323. 7	2, 608, 108	1, 692, 321	105. 6	7, 110, 514	4, 630, 010	215. 5	8, 368, 184	5, 352, 729	250. 9
New York	72, 813, 420	37, 263, 860	231. 4	23, 018, 075	10, 349, 419	43. 7	92, 976, 830	46, 117, 393	185. 6	51, 728, 770	25, 647, 645	304. 4
North Carolina	22, 659, 309	10, 892. 564	571. 0	5, 962, 435	2, 854, 229	182. 7	20, 193, 556	9, 698, 060	470. 9	23, 925, 231	11, 817, 277	652. 2
North Dakota	8, 059, 145	4, 182, 387	1, 390. 5	4, 401, 217	2, 201, 608	273. 3	10, 013, 968	5, 033, 160	672. 9	13, 232, 482	6, 872, 776	1, 075. 7

Ohio	50, 796, 032	24, 012, 418	490. 1	23, 255, 683	11, 927, 220	128. 6	41, 811, 448	20, 272, 330	200. 7	37, 772, 769	19, 547, 601	193. 6
Oklahoma	22, 834, 842	12, 526, 907	301. 9	11, 595, 741	5, 374, 081	342. 1	15, 316, 972	7, 494, 148	405. 1	21, 477, 855	10, 746, 766	1, 146. 2
Oregon	7, 233, 216	4, 194, 000	96. 2	1, 969, 770	1, 151, 575	29. 9	13, 672, 018	7, 769, 023	210. 7	8, 337, 382	4, 635, 864	138. 0
Pennsylvania	38, 896, 374	19, 087, 187	101. 8	17, 835, 473	8, 869, 486	37. 6	73, 953, 505	36, 544, 789	170. 0	39, 214, 002	20, 088, 048	157. 8
Rhode Island	9, 661, 936	4, 918, 068	63. 8	1, 737, 068	887, 798	2. 4	10, 269, 484	5, 126, 053	7. 5	2, 772, 910	1, 510, 799	15. 6
South Carolina	9, 303, 245	4, 584, 932	272. 1	1, 493, 141	799, 486	106. 6	12, 499, 424	6, 288, 735	492. 5	8, 304, 066	4, 405, 113	337. 6
South Dakota	12, 631, 612	7, 322, 112	1, 190. 2	4, 174, 271	2, 532, 902	367. 2	7, 630, 654	4, 661, 072	568. 7	11, 556, 467	6, 994, 069	867. 1
Tennessee	15, 259, 058	7, 392, 479	329. 3	12, 342, 652	5, 916, 572	335. 2	19, 344, 308	9, 297, 634	337. 3	25, 955, 482	14, 215, 820	486. 3
Texas	6, 222, 690	3, 175, 925	428. 1	12, 296, 055	6, 451, 648	552. 5	56, 276, 796	25, 629, 685	1, 667. 2	61, 695, 187	32, 418, 518	1, 978. 6
Utah	5, 178, 720	3, 799, 657	177. 7	1, 590, 098	1, 151, 163	62. 9	5, 831, 489	4, 259, 599	119. 8	5, 461, 865	3, 868, 757	185. 2
Vermont	2, 721, 200	1, 484, 000	40. 4	1, 548, 402	747, 759	4. 6	3, 567, 814	1, 615, 894	34. 5	4, 054, 413	1, 975, 612	52. 8
Virginia	25, 785, 534	12, 915, 923	561. 4	5, 111, 471	2, 533, 276	150. 6	18, 890, 954	10, 328, 642	283. 1	13, 916, 170	7, 818, 687	292. 4
Washington	13, 256, 021	6, 086, 143	132. 9	3, 329, 215	1, 618, 965	98. 4	19, 398, 453	8, 879, 620	126. 9	11, 072, 568	4, 995, 724	156. 7
West Virginia	16, 904, 778	7, 250, 960	180. 7	2, 006, 256	1, 010, 848	35. 9	10, 447, 592	5, 231, 235	65. 1	8, 081, 182	3, 926, 173	151. 2
Wisconsin	24, 911, 346	12, 753, 534	473. 8	5, 471, 073	2, 629, 010	242. 0	16, 871, 939	8, 202, 002	384. 5	27, 101, 737	12, 781, 605	602. 6
Wyoming	3, 528, 454	2, 130, 762	67. 3	1, 282, 255	808, 348	63. 4	7, 863, 925	5, 184, 528	334. 9	7, 781, 527	4, 992, 396	341. 7
District of Columbia	5, 699, 886	3, 062, 443	7. 5	119, 049	59, 500	. 5	396, 246	198, 123		15, 869, 867	7, 362, 852	3. 4
Hawaii	8, 035, 780	3, 714, 077	24. 0	2, 187, 250	962, 225	. 5	4, 287, 902	2, 000, 811	21. 3	4, 320, 897	2, 449, 398	25. 0
Puerto Rico	4, 069, 420	1, 818, 720	17. 0	1, 434, 680	662, 068	6. 4	10, 842, 227	4, 575, 067	47. 5	3, 316, 700	1, 402, 063	23. 8
Total	796, 043, 688	404, 215, 888	17, 099. 1	315, 520, 660	156, 885, 786	7, 304. 1	1, 008, 947, 783	505, 879, 473	14, 384. 6	867, 822, 645	449, 815, 444	20, 207. 9

---

[1] Includes projects financed from postwar Federal-aid primary, secondary, and urban, prewar Federal-aid primary, secondary, and grade crossing, emergency highway and grade crossing, and Defense Highway Act funds.

[2] Initial commitment of funds.

Table 8.—*Status of projects as of June 30, 1950, and projects completed during the fiscal year,[1] on Federal-aid highway system in rural areas*

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$6,323,157	$3,218,650	77.8	$2,391,309	$1,204,221	29.9	$5,602,929	$2,730,943	89.1	$2,703,017	$1,406,147	84.4
Arizona	1,985,387	1,411,853	34.2	893,947	633,272	12.6	3,444,870	2,468,441	35.2	4,155,516	2,824,918	60.9
Arkansas	6,388,957	3,527,232	125.4	5,318,643	2,582,241	94.7	7,780,951	3,855.496	116.4	6,431.296	4,137,577	35.7
California	13,607,793	3,875,167	35.9	5,780,385	2,493,207	28.7	16,615,272	8,398,596	108.6	10,155,575	5,006,032	55.6
Colorado	3,823,716	2,138,496	61.8	1,045,448	551,220	43.3	5,747,308	3,191,632	110.1	7,014,167	3,967,409	125.9
Connecticut	3,150,000	1,275,000	5.8	37,272	18,636	----------	995,020	749,849	2.4	2,195,474	1,129,293	11.7
Delaware	1,371,234	690,417	5.4	1,395,859	697,929	1.1	2,771,943	1,332,362	16.0	2,114,446	1,572.917	9.4
Florida	9,410,382	4,770,789	215.5	2,447,446	1,383,771	39.9	5,106,448	2,851,304	116.7	813.329	470,856	11.6
Georgia	10,304,900	5,395,810	200.1	1,530,146	765,073	22.8	16,514,297	8,168,870	175.4	11,199,995	5,678,235	260.4
Idaho	5,135,587	3,216,351	110.4	984,663	550,812	13.8	3,677,887	2,287,425	77.5	1,722,998	1,089,453	36.5
Illinois	13,160,648	6,647,598	93.6	4,343,374	2,193,587	55.0	17,424,191	8,574,604	172.5	16,216,958	8,634,214	265.1
Indiana	6,884,876	3,514,613	22.9	2,568.703	1,292,748	19.5	5,898,786	3,339,225	15.6	9,170,261	4,585,845	67.8
Iowa	5,409,684	1,817,334	227.6	3,479,637	1,123,680	70.2	13,604,823	6,367,814	287.4	12,320,253	6,158,522	235.5
Kansas	4,938,412	2,476,552	119.3	2,575,484	1,295,644	106.1	9,879,840	4,928,927	239.8	15,810,350	7,967,622	440.6
Kentucky	5,591.991	2,797,995	46.6	4,294,097	2,152,212	80.9	7,883,752	3,779,597	81.7	8,448,708	4,290,959	112.6
Louisiana	14,804,278	7,396,524	158.5	2,674,223	1,371,010	27.6	4,213,744	2,257,451	27.4	4,881,421	2,520.236	63.1
Maine	4,908,500	2,677,850	47.3	610,829	363,952	3.7	2,581,330	1,281,028	23.1	4,061,113	1,999,722	39.2
Maryland	1,899,070	900,712	2.6	1,700,326	681,163	1.8	9,061,237	4,611,983	37.5	3.263,502	1,650,522	11.8
Massachusetts	7,341,500	3,900,750	6.8	388,964	194,482	----------	1,989,270	974,912	4.9	2,840,914	1,798.422	25.7
Michigan	6,070,900	3,362,750	118.0	3,912,158	1,949,642	46.0	6,714,500	2,817,200	83.3	13,906,683	6,929.458	201.1
Minnesota	2,025,500	926,900	39.7	5,617,840	2.797,944	169.6	10,656,559	5,273,935	233.4	10,885.381	5.456,994	285.8
Mississippi	162,000	81,000	.3	2.331,100	1,165,550	105.1	1,965,324	978,062	52.4	8,854,670	4,378,216	144.9
Missouri	11,315.368	5,830,084	135.1	4,864.115	2,429,636	40.9	12,265,974	6,594,153	130.4	11,733,075	5.733,016	150.1
Montana	11,765,442	5,926,767	287.1	2,359,918	1,558,703	72.9	9,409,803	5,755,627	192.0	6 183,077	3,628,355	169.4
Nebraska	10,043.900	5,067,950	345.4	1,879,844	931,888	46.2	5,714,836	2,842,331	153.5	6,504,996	3,232,179	194.1
Nevada	3,027,992	2,491,808	55.8	48,093	38,474	----------	2,875,862	2,361,521	78.2	2,698.728	2.168,501	56.3
New Hampshire	2,481,737	1,237,690	23.1	461,438	213,623	2.9	2,221.153	1,078,861	12.1	1,196,802	621,612	7.7
New Jersey	239,609	85,718	1.1	3,996,736	1,993,198	6.1	775,063	384.640	1.9	1,142,372	520.596	4.2
New Mexico	5,747,967	3,667,203	91.2	592.196	377,821	5.0	3,071,461	2,044,640	55.3	5,122,856	3,272,734	108.0
New York	11,163,406	5,059,703	31.4	7,504,246	3,379.297	34.8	23,984.150	12.613,029	79.9	30,145,984	15,004,669	149.6
North Carolina	15,895,167	7,628,247	350.3	2,575,321	1,227,161	58.8	5,338,028	2,724,301	71.3	9,974,799	5.107,394	228.2
North Dakota	846,189	565,509	10.1	3,440,758	1,720,459	152.6	5.546,684	2,760.661	172.4	6,727,338	3,372,946	305.0

Ohio	10, 011, 500	4, 781, 540	54. 8	12, 924, 674	6, 849, 040	49. 6	24, 538, 629	12, 272, 261	124. 3	10, 859, 393	5, 702, 705	54. 1
Oklahoma	12, 096, 074	6, 903, 519	134. 2	2, 543, 894	1, 402, 600	51. 5	7, 789, 407	4, 014, 874	150. 9	11, 895, 366	5, 888, 272	369. 9
Oregon	1, 878, 000	1, 136, 000	19. 7	1, 137, 726	686, 841	11. 9	5, 432, 038	3, 110, 400	71. 1	5, 752, 670	3, 182, 635	69. 4
Pennsylvania	9, 646, 156	4, 823, 078	21. 9	3, 055, 854	1, 505, 833	10. 2	15, 932, 558	7, 965, 188	70. 2	15, 588, 197	7, 952, 056	46. 7
Rhode Island	3, 027, 352	1, 513, 276	9. 0	160, 577	120, 047	-------	482, 306	241, 153	-------	15, 000	7, 500	-------
South Carolina	6, 008, 692	3, 037, 192	104. 7	225, 490	111, 500	. 7	4, 836, 976	2, 566, 038	48. 0	3, 234, 467	1, 770, 718	66. 7
South Dakota	4, 495, 249	2, 628, 201	278. 1	2, 384, 350	1, 471, 347	130. 8	3, 843, 375	2, 304, 920	209. 6	5, 604, 118	3, 420, 293	256. 1
Tennessee	1, 946, 638	1, 163, 069	16. 2	6, 053, 128	2, 645, 518	48. 5	9, 684, 126	4, 597, 300	83. 6	13, 437, 131	7, 268, 307	83. 1
Texas	194, 200	119, 200	. 9	3, 603, 065	2, 043, 140	55. 4	19, 489, 200	9, 331, 700	315. 4	27, 102, 588	13, 928, 000	518. 0
Utah	2, 022, 080	1, 475, 491	37. 5	900, 303	651, 924	29. 0	2, 989, 375	2, 176, 402	47. 8	3, 512, 632	2, 526, 621	89. 9
Vermont	1, 677, 000	961, 900	31. 2	956, 055	451, 465	. 9	2, 405, 932	1, 045, 425	16. 7	2, 297, 772	1, 129, 906	35. 0
Virginia	14, 369, 301	7, 261, 134	142. 2	2, 793, 225	1, 388, 719	35. 4	7, 240, 375	3, 998, 807	46. 3	5, 622, 899	3, 721, 175	25. 4
Washington	2, 168, 782	1, 147, 831	11. 3	871, 172	428, 879	29. 3	9, 917, 617	4, 109, 162	65. 5	7, 696, 648	3, 283, 541	53. 5
West Virginia	6, 186, 066	2, 859, 700	37. 7	899, 868	449, 934	5. 6	3, 336, 420	1, 688, 085	13. 4	2, 138, 764	1, 022, 248	13. 7
Wisconsin	16, 661, 022	8, 713, 387	255. 2	1, 981, 991	955, 800	39. 7	10, 034, 229	5, 039, 152	155. 8	8, 902, 628	4, 331, 252	136. 6
Wyoming	2, 071, 499	1, 174, 212	27. 5	616, 993	399, 168	10. 7	4, 772, 464	3, 177, 658	136. 0	4, 911, 399	3, 157, 501	120. 5
Hawaii	2, 216, 754	1, 076, 710	7. 8	527, 944	263, 972	-------	3, 500, 136	1, 710, 868	20. 6	1, 723, 939	1, 057, 335	10. 9
Puerto Rico	1, 279, 456	603, 353	3. 2	1, 076, 751	489, 461	3. 1	4, 093, 699	1, 892, 403	14. 3	808, 057	371, 819	6. 3
Total	305, 181, 070	154, 959, 815	4, 279. 2	126, 757, 578	63, 647, 444	1, 904. 8	371, 652, 157	191, 621, 216	4, 642. 9	371, 699, 122	196, 037, 485	5, 914. 3

---

[1] Includes projects on rural portions of the Federal-aid highway system financed from postwar Federal-aid primary, prewar Federal-aid primary and grade crossing, emergency highway and grade crossing, and Defense Highway Act funds.

[2] Initial commitment of funds.

Table 9.—*Status of projects as of June 30, 1950, and projects completed during the fiscal year,*[1] *on secondary roads in rural areas*

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$6, 289, 512	$2, 990, 093	340. 2	$1, 657, 152	$823, 424	126. 7	$3, 711, 099	$1, 807, 250	171. 6	$5, 918, 989	$2, 853, 363	418. 2
Arizona	1, 271, 281	860, 092	52. 8	495, 765	337, 765	20. 2	2, 625, 768	1, 872, 910	81. 0	3, 472, 363	2, 326, 064	46. 7
Arkansas	2, 847, 848	1, 439, 164	155. 8	4, 542, 820	2, 266, 316	194. 4	4, 707, 454	2, 354, 409	177. 3	3, 726, 167	1, 958, 924	127. 2
California	9, 330, 757	4, 428, 923	196. 3	2, 511, 247	1, 192, 685	57. 6	5, 638, 784	2, 694, 016	83. 3	10, 209, 643	4, 493, 164	213. 0
Colorado	1, 363, 192	753, 526	65. 8	1, 178, 003	671, 550	48. 7	4, 108, 724	2, 361, 681	177. 6	4, 946, 897	2, 781, 134	188. 6
Connecticut	1, 240, 000	607, 500	4. 5	442, 399	217, 664	3. 1	489, 194	242, 516	1. 2	972, 607	523, 843	6. 8
Delaware	1, 270, 968	639, 144	35. 1	914, 120	454, 340	14. 6	2, 070, 084	962, 423	39. 8	874, 749	430, 186	20. 3
Florida	3, 456, 694	1, 594, 897	223. 1	2, 089, 622	929, 615	82. 2	3, 570, 404	1, 735, 872	128. 5	4, 245, 189	1, 731, 248	138. 0
Georgia	3, 432, 750	1, 812, 375	210. 8	3, 153, 680	1, 593, 888	162. 0	11, 484, 892	5, 966, 675	545. 2	12, 280, 347	6, 146, 595	477. 3
Idaho	3, 483, 500	2, 190, 996	228. 9	460, 839	285, 231	31. 0	1, 970, 741	1, 195, 903	101. 9	2, 024, 993	1, 234, 030	96. 2
Illinois	6, 311, 899	2, 988, 273	237. 4	1, 842, 436	900, 204	80. 9	5, 449, 452	2, 657, 740	160. 9	9, 145, 580	4, 606, 814	255. 4
Indiana	4, 812, 178	2, 272, 712	32. 2	3, 537, 872	1, 772, 527	40. 7	3, 323, 189	1, 554, 970	32. 7	5, 824, 021	2, 800, 918	62. 7
Iowa	5, 502, 060	2, 761, 988	363. 9	2, 304, 891	1, 164, 788	276. 1	5, 973, 887	2, 909, 966	467. 2	10, 374, 380	5, 148, 348	767. 0
Kansas	4, 474, 318	2, 244, 362	1, 024. 3	1, 678, 081	861, 370	372. 9	3, 878, 171	1, 944, 327	352. 0	8, 638, 282	4, 300, 875	1, 634. 8
Kentucky	5, 527, 014	2, 763, 507	142. 3	3, 451, 489	1, 703, 968	69. 9	6, 691, 442	3, 345, 221	201. 3	3, 035, 587	1, 524, 018	81. 9
Louisiana	2, 904, 432	1, 173, 266	48. 9	3, 801, 157	1, 995, 824	72. 7	7, 375, 237	3, 350, 070	143. 9	6, 676, 552	2, 787, 637	85. 5
Maine	4, 824, 773	2, 567, 015	79. 5	449, 435	242, 767	5. 0	2, 866, 152	1, 427, 611	53. 5	1, 508, 708	749, 722	26. 2
Maryland	1, 116, 078	558, 039	21. 5	428, 441	214, 184	24. 7	1, 930, 597	915, 750	26. 6	3, 229, 514	2, 007, 059	61. 8
Massachusetts	685, 000	334, 088	4. 9	1, 239, 990	576, 806	6. 5	1, 349, 991	758, 544	7. 6	670, 768	318, 089	6. 7
Michigan	7, 655, 600	3, 803, 550	481. 0	3, 453, 503	1, 730, 850	209. 9	3, 160, 963	1, 578, 981	104. 0	6, 953, 330	3, 312, 660	325. 1
Minnesota	5, 602, 668	2, 802, 564	1, 071. 2	4, 363, 674	2, 171, 027	588. 9	2, 426, 692	1, 217, 901	254. 9	5, 922, 892	2, 903, 272	621. 6
Mississippi	5, 662, 350	2, 842, 975	300. 9	534, 700	265, 800	25. 2	2, 800, 170	1, 362, 485	117. 3	7, 523, 987	3, 734, 298	310. 0
Missouri	8, 269, 947	4, 220, 189	707. 7	2, 148, 009	1, 073, 191	238. 6	4, 986, 485	2, 496, 796	458. 0	8, 366, 064	4, 234, 361	688. 8
Montana	4, 437, 086	2, 531, 271	323. 0	1, 643, 484	912, 495	75. 1	3, 189, 573	1, 882, 958	178. 5	3, 219, 974	1, 804, 231	182. 1
Nebraska	7, 064, 306	3, 838, 964	311. 0	1, 008, 288	513, 845	28. 0	5, 053, 437	2, 531, 077	156. 2	4, 325, 667	2, 168, 009	222. 8
Nevada	2, 446, 153	2, 022, 273	134. 3	171, 341	140, 813	3. 2	1, 882, 646	1, 535, 284	106. 1	1, 588, 655	1, 242, 579	127. 1
New Hampshire	2, 873, 490	1, 434, 245	31. 9	16, 000	7, 000	----------	1, 125, 547	538, 199	12. 5	1, 268, 028	702, 489	12. 8
New Jersey	1, 336, 000	668, 000	9. 7	688, 379	344, 189	. 3	2, 381, 896	1, 013, 029	6. 1	1, 572, 482	747, 632	23. 0
New Mexico	4, 065, 661	2, 593, 787	232. 6	1, 760, 892	1, 136, 762	99. 5	2, 884, 178	1, 848, 559	147. 9	2, 412, 757	1, 549, 065	131. 8
New York	14, 446, 406	7, 425, 703	164. 6	610, 282	289, 397	2. 2	6, 733, 953	3, 255, 187	57. 8	9, 415, 689	4, 607, 645	127. 9
North Carolina	4, 722, 252	2, 304, 427	206. 4	2, 355, 514	1, 188, 043	113. 4	7, 921, 208	3, 951, 934	365. 8	9, 412, 261	4, 624, 196	388. 8
North Dakota	7, 099, 548	3, 558, 214	1, 379. 9	960, 359	481, 059	120. 7	3, 722, 077	1, 932, 191	483. 4	4, 206, 191	2, 369, 968	718. 4

Ohio	10, 229, 832	5, 213, 078	414. 0	2, 989, 333	1, 547, 450	65. 4	8, 097, 092	3, 810, 715	58. 8	8, 342, 984	4, 103, 764	125. 2
Oklahoma	3, 594, 903	1, 602, 113	137. 6	7, 063, 823	2, 978, 833	288. 0	5, 826, 330	2, 576, 686	249. 5	8, 594, 396	4, 346, 915	771. 2
Oregon	3, 701, 795	2, 196, 000	75. 5	525, 607	293, 122	18. 0	4, 446, 917	2, 567, 913	131. 3	1, 952, 769	1, 144, 222	65. 5
Pennsylvania	8, 061, 896	4, 030, 948	68. 4	2, 197, 898	1, 098, 949	11. 8	8, 353, 276	4, 170, 508	83. 4	10, 418, 908	5, 130, 266	97. 1
Rhode Island	4, 055, 736	2, 115, 368	52. 6	79, 259	39, 135	2. 1	198, 177	86, 018		311, 026	294, 501	1. 7
South Carolina	1, 731, 111	831, 208	157. 8	1, 121, 065	541, 400	105. 9	5, 064, 186	2, 525, 277	440. 3	3, 556, 718	1, 802, 749	264. 7
South Dakota	7, 825, 535	4, 519, 322	909. 4	1, 777, 830	1, 049, 464	236. 4	3, 045, 427	1, 762, 018	357. 9	5, 810, 307	3, 495, 635	609. 8
Tennessee	6, 819, 960	3, 258, 180	309. 6	4, 362, 360	2, 383, 972	282. 0	5, 590, 148	3, 019, 129	250. 7	6, 624, 345	3, 297, 065	398. 4
Texas	4, 476, 590	2, 280, 775	425. 7	5, 193, 060	2, 581, 158	455. 2	16, 986, 683	8, 518, 085	1, 319. 1	15, 070, 726	7, 536, 597	1, 323. 2
Utah	2, 678, 640	1, 972, 250	133. 6	492, 664	355, 887	31. 1	1, 809, 329	1, 324, 669	64. 5	1, 905, 329	1, 312, 277	95. 3
Vermont	824, 200	412, 100	7. 4	556, 109	278, 055	3. 6	1, 144, 608	561, 832	17. 8	862, 406	427, 786	15. 3
Virginia	9, 377, 720	4, 741, 365	411. 8	2, 260, 034	1, 119, 711	115. 0	8, 092, 983	4, 665, 290	229. 4	5, 137, 557	2, 656, 210	256. 9
Washington	4, 657, 147	1, 954, 412	120. 2	1, 767, 260	854, 386	65. 7	5, 704, 656	2, 769, 273	58. 8	2, 752, 531	1, 353, 435	99. 8
West Virginia	6, 289, 300	3, 191, 260	141. 2	1, 084, 860	550, 150	30. 2	3, 137, 720	1, 579, 470	46. 5	3, 971, 741	1, 938, 655	125. 5
Wisconsin	5, 085, 604	2, 318, 621	211. 1	1, 937, 940	936, 070	198. 2	4, 787, 465	2, 172, 054	214. 8	9, 802, 740	4, 302, 844	423. 7
Wyoming	1, 299, 453	854, 269	37. 7	468, 297	304, 297	52. 7	2, 821, 101	1, 833, 131	196. 9	2, 788, 638	1, 787, 352	221. 2
Hawaii	3, 657, 490	1, 743, 245	14. 7	134, 226	57, 113	. 4	21, 936	10, 968		1, 761, 025	945, 348	13. 8
Puerto Rico	1, 386, 675	675, 338	9. 8				2, 867, 270	1, 251, 442	21. 5	1, 390, 792	638, 993	11. 9
Total	231, 579, 308	118, 935, 974	12, 460. 5	89, 905, 489	45, 428, 539	5, 156. 6	215, 479, 391	110, 406, 913	9, 142. 8	255, 018, 251	129, 237, 080	13, 514. 7

---

[1] Includes projects on secondary roads in rural areas financed from postwar Federal-aid secondary, prewar Federal-aid secondary and grade crossing, emergency highway and grade crossing, and Defense Highway Act funds.

[2] Initial commitment of funds.

Table 10.—*Status of projects as of June 30, 1950, and projects completed during the fiscal year,*[1] *in urban areas*

State or Territory	Programed,[2] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$1, 579, 800	$936, 400	1. 7	$765, 930	$314, 965	----------	$3, 239, 368	$1, 965, 699	8. 4	$1, 757, 700	$1, 468, 540	0. 9
Arizona	890, 000	635, 134	4. 5	----------	----------	----------	4, 916	3, 493	----------	605, 002	354, 228	2. 9
Arkansas	1, 874, 878	1, 250, 989	6. 7	906, 080	436, 701	16. 0	1, 880, 345	863, 791	30. 0	2, 930, 345	1, 018, 299	1. 8
California	13, 545, 615	6, 138, 392	6. 7	206, 794	120, 271	----------	16, 428, 900	8, 078, 148	25. 8	20, 671, 979	10, 636, 262	21. 5
Colorado	415, 979	214, 910	1. 0	695, 955	493, 306	4. 2	6, 026, 945	3, 620, 152	13. 2	1, 419, 948	814, 004	21. 4
Connecticut	6, 044, 206	3, 167, 103	15. 0	1, 544, 185	745, 246	4. 0	5, 079, 664	2, 805, 025	4. 7	7, 611, 977	3, 880, 637	6. 4
Delaware	----------	----------	----------	64, 500	32, 250	----------	187, 693	92, 291	2. 7	626, 802	336, 029	1. 8
Florida	3, 298, 248	1, 879, 624	13. 1	1, 641, 923	1, 117, 835	4. 9	1, 980, 811	818, 366	22. 0	2, 336, 402	1, 107, 052	18. 0
Georgia	2, 165, 000	1, 051, 000	6. 6	1, 741, 464	853, 232	6. 1	14, 209, 944	6, 303, 378	11. 2	524, 274	275, 895	2. 0
Idaho	300, 413	188, 028	1. 5	347, 815	270, 784	1. 5	1, 155, 661	767, 251	. 2	5, 071	3, 136	----------
Illinois	28, 169, 229	15, 178, 614	36. 4	14, 223, 601	7, 089, 866	30. 8	26, 512. 984	12, 526, 872	20. 3	11, 723, 388	5, 818, 123	80. 4
Indiana	6, 289, 312	3, 705, 961	11. 9	1, 417, 262	711, 331	3. 8	4, 027, 956	2, 015, 834	7. 6	3, 281, 902	2, 070, 288	12. 9
Iowa	2, 484, 939	1, 378, 154	15. 5	1, 049, 580	365, 704	5. 5	1, 515, 356	969, 071	4. 2	2, 423, 083	1, 604, 279	15. 1
Kansas	2, 371, 992	1, 314, 494	5. 5	641, 124	320, 562	5. 3	1, 298, 783	862, 803	2. 7	1, 435, 207	677, 442	5. 6
Kentucky	3, 643, 778	1, 679, 389	11. 8	1, 584, 763	781, 781	17. 9	662, 440	392, 821	6. 1	3, 244, 638	1, 748, 710	24. 1
Louisiana	2, 240, 822	1, 095, 411	4. 5	1, 912, 072	738, 690	9. 9	5, 292, 084	3, 102, 670	12. 2	4, 583, 660	2, 257, 119	1. 5
Maine	228, 400	114, 200	1. 0	216, 564	108, 282	. 8	555, 986	267, 708	4. 1	113, 306	58, 502	. 5
Maryland	4, 561, 712	2, 196, 986	4. 8	792, 400	303, 200	. 8	6, 997, 300	3, 582, 138	4. 0	4, 470, 387	2, 230, 900	6. 3
Massachusetts	6, 550, 000	2, 475, 598	3. 9	4, 586, 667	2, 406, 369	1. 0	54, 963, 465	26, 502, 596	46. 2	8, 016, 369	4, 132, 193	46. 5
Michigan	3, 732, 116	1, 866, 058	. 6	2, 160, 662	1, 073, 749	8. 1	34, 844, 092	13, 658, 221	16. 3	6, 946, 450	3, 421, 691	10. 2
Minnesota	4, 421, 000	2, 626, 500	13. 4	1, 172, 934	827, 438	3. 1	7, 359, 438	4, 262, 226	24. 7	5, 500, 183	2, 848, 101	30. 6
Mississippi	----------	----------	----------	4, 800	4, 800	----------	1, 769, 272	1, 084, 086	27. 2	1, 288, 925	725, 247	18. 5
Missouri	10, 154, 804	5, 682, 958	5. 6	4, 398, 223	1, 552, 077	----------	13, 776, 069	6, 379, 683	17. 4	4, 331, 823	2, 471, 730	13. 6
Montana	189, 344	107, 305	. 6	51, 513	30, 886	1. 0	2, 136, 415	1, 467, 932	3. 7	642, 244	356, 871	8. 9
Nebraska	2, 025, 300	1, 007, 350	7. 8	1, 243, 950	498, 936	. 5	2, 395, 226	2, 155, 724	. 4	56, 500	50, 950	----------
Nevada	----------	----------	----------	1, 088	807	----------	724, 108	596, 405	4. 0	573, 085	502, 085	. 5
New Hampshire	592, 660	288, 830	3. 6	46, 975	21, 487	----------	475, 267	230, 433	3. 3	1, 039, 992	741, 427	2. 0
New Jersey	2, 928, 748	1, 398, 671	. 7	5, 193, 584	2, 482, 077	5. 9	14, 363, 633	7, 015, 688	18. 7	27, 202, 797	13, 249, 961	20. 6
New Mexico	5, 373	3, 428	----------	255, 020	177, 739	1. 1	1, 154, 876	736, 811	12. 3	832, 571	530, 931	11. 1
New York	47, 203, 608	24, 778, 454	35. 4	14, 903, 547	6, 680, 725	6. 7	62, 258, 726	30, 249, 177	47. 9	12, 167, 097	6, 035, 330	26. 9
North Carolina	2, 041, 890	959, 890	14. 2	1, 031, 600	439, 025	10. 5	6, 934, 320	3, 021, 825	33. 8	4, 538, 171	2, 085, 687	35. 1
North Dakota	113, 408	58, 664	. 6	100	90	----------	745, 206	340, 308	17. 1	2, 298, 954	1, 129, 862	52. 3

Ohio	30, 554, 700	14, 017, 800	21.3	7, 341, 677	3, 530, 730	13.7	9, 175, 728	4, 189, 355	17.6	18, 570, 393	9, 741, 132	14.3
Oklahoma	7, 143, 865	4, 021, 276	30.1	1, 988, 024	992, 648	2.7	1, 701, 235	902, 589	4.7	988, 092	511, 578	5.1
Oregon	1, 653, 421	862, 000	.9	306, 437	171, 612		3, 793, 062	2, 090, 710	8.3	631, 942	309, 007	3.1
Pennsylvania	21, 188, 322	10, 233, 161	11.5	12, 581, 721	6, 264, 704	15.6	49, 667, 670	24, 409, 093	16.4	13, 206, 898	7, 005, 726	14.1
Rhode Island	2, 578, 848	1, 289, 424	2.3	1, 497, 232	728, 616	.3	9, 589, 001	4, 798, 883	7.5	2, 446, 884	1, 208, 799	13.9
South Carolina	1, 563, 443	716, 532	9.6	146, 586	146, 586		2, 598, 262	1, 197, 420	4.2	1, 512, 881	831, 646	6.2
South Dakota	310, 827	174, 589	2.7	12, 091	12, 091		741, 852	594, 135	1.2	142, 042	78, 142	.6
Tennessee	6, 492, 460	2, 971, 230	3.5	1, 927, 164	887, 082	4.7	4, 070, 034	1, 681, 205	3.0	5, 894, 005	3, 650, 448	4.8
Texas	1, 551, 900	775, 950	1.5	3, 499, 930	1, 827, 350	41.9	19, 800, 912	7, 779, 900	32.7	19, 521, 872	10, 953, 921	137.3
Utah	478, 000	351, 916	6.6	197, 130	143, 352	2.8	1, 032, 786	758, 528	7.5	43, 904	29, 859	
Vermont	220, 000	110, 000	1.7	36, 238	18, 239		17, 274	8, 637		894, 235	417, 920	2.5
Virginia	2, 038, 513	913, 424	7.4	58, 212	24, 846	.2	3, 557, 597	1, 664, 545	7.4	3, 155, 714	1, 441, 302	10.1
Washington	6, 430, 092	2, 983, 900	1.4	690, 783	335, 700	3.4	3, 776, 180	2, 001, 185	2.6	623, 989	358, 749	3.4
West Virginia	4, 429, 412	1, 200, 000	1.8	21, 528	10, 764		3, 973, 452	1, 963, 680	5.2	1, 970, 677	965, 270	12.0
Wisconsin	3, 164, 720	1, 721, 526	7.4	1, 551, 142	737, 140	4.1	2, 050, 246	990, 796	13.9	8, 396, 369	4, 147, 508	42.3
Wyoming	157, 502	102, 281	2.1	196, 965	104, 883		270, 361	173, 739	2.0	81, 491	47, 543	
District of Columbia	5, 699, 886	3, 062, 443	7.5	119, 049	59, 500	.5	396, 246	198, 123		15, 869, 867	7, 362, 852	3.4
Hawaii	2, 161, 536	894, 122	1.6	1, 525, 080	641, 140		765, 830	278, 975	.7	835, 934	446, 715	.3
Puerto Rico	1, 403, 289	540, 030	3.9	357, 929	172, 607	3.3	3, 881, 258	1, 431, 222	11.7	1, 117, 851	391, 251	5.6
Total	259, 283, 310	130, 320, 099	359.4	98, 857, 593	47, 809, 801	242.6	421, 816, 235	203, 851, 346	599.0	241, 105, 272	124, 540, 879	778.9

---

[1] Includes projects in urban areas financed from postwar Federal-aid primary, secondary, and urban, prewar Federal-aid primary, secondary, and grade crossing, emergency highway and grade crossing, and Defense Highway Act funds.

[2] Initial commitment of funds.

Table 11.—*Interstate system improvements financed with postwar Federal-aid funds: Status of projects as of June 30, 1950, and projects completed during the fiscal year*

State or Territory	Programed,[1] plans not approved			Plans approved, not under construction			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama	$3,686,900	$1,847,200	29.0	$471,800	$223,900	0.1	$4,371,653	$2,539,069	33.2	$3,014,617	$2,079,929	20.6
Arizona	1,810,000	1,288,134	29.6	893,947	633,272	12.6	2,147,840	1,551,416	33.0	3,369,071	2,342,338	58.3
Arkansas	2,572,750	1,469,375	42.5	1,361,255	626,410	22.8	1,636,190	766,105	18.3	3,146,978	1,129,312	.1
California	18,734,200	7,715,928	27.2	5,550,900	2,359,739	28.7	19,192,200	9,686,548	74.0	18,477,233	8,979,828	45.0
Colorado	1,629,000	909,501	19.5	852,195	565,935	9.9	6,380,459	3,645,037	41.6	2,356,764	1,247,296	15.5
Connecticut	4,878,299	2,164,150	9.2	856,487	411,532	3.0	2,046,163	1,010,426	.7	2,396,564	1,044,735	10.9
Delaware	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Florida	4,706,000	2,428,200	67.4	2,439,469	1,604,728	22.1	2,084,833	870,377	52.5	2,173,813	1,034,111	12.6
Georgia	5,365,000	2,740,600	33.7	1,605,000	785,000	6.1	14,954,702	5,861,262	18.6	1,526,595	750,567	21.2
Idaho	2,538,000	1,588,512	47.0	-----	-----	-----	789,364	512,930	22.2	649,229	404,211	12.6
Illinois	25,343,200	12,865,100	39.4	12,876,850	6,357,500	30.5	24,957,170	11,829,095	36.3	10,585,905	5,374,337	76.3
Indiana	5,976,550	3,538,475	9.6	1,778,300	889,150	13.2	4.407,972	2,592,489	7.3	4,471,370	2,205,023	23.8
Iowa	-----	-----	-----	103,033	51,516	-----	-----	-----	-----	1,309,742	653,805	19.0
Kansas	1,223,000	611,500	15.1	358,784	177,742	9.1	1,710,704	855,352	27.0	2,307,950	1,101,555	28.1
Kentucky	2,312,312	1,154,156	21.1	2,870,873	1,435,437	35.1	2,700,186	1,350,093	31 0	2,373,591	1,186,795	25.2
Louisiana	5,909,900	2.950,800	57.0	2,190,800	830,400	5.9	5,146,740	3,023,370	7.1	4,648.478	2,273,385	2.0
Maine	582,200	349,850	3.6	39,000	15,000	-----	2,115,609	1,037,117	20.8	1,024,438	504,114	7.1
Maryland	4,750,000	2,326,177	3.0	2,371,000	923,500	2.6	8,617,034	4,391,755	9.4	2,822,800	1,410,625	2.9
Massachusetts	7,545,500	3.772,750	7.1	600,000	200,000	-----	13,810.295	6,459,572	9.3	-----	-----	-----
Michigan	4,183,116	2,091,558	13.6	1,818,250	909,125	10.2	34,485,373	13,569,931	29.2	5,493,525	2,721,704	10.3
Minnesota	527.500	255,750	3.4	1,767,138	883,569	37.8	1,340,847	731,950	.5	6.737,307	3,396,404	87.7
Mississippi	-----	-----	-----	-----	-----	-----	952,300	675,600	5.0	1,016,359	545,648	18.5
Missouri	12,514,968	6,782,484	55.2	7,209,278	3,048,454	25.8	15,667,962	7,420,476	69.0	3,797,981	1,731,350	14.5
Montana	4,816,500	2,531,964	108.0	457,832	251,232	6.7	4,184,389	2,529,559	48.8	1,663,865	1,085,685	25.3
Nebraska	378.000	189,000	15.3	15,403	8,143	-----	13,400	4,700	-----	678,050	339,225	9.3
Nevada	1,957.500	1,607,691	22.9	-----	-----	-----	564,126	466,067	13.1	909,928	726,306	8.9
New Hampshire	251,000	119,000	1.6	14,000	5,000	-----	266,904	133,452	3.5	1,247,905	837,487	3.1
New Jersey	-----	-----	-----	4,982,950	2,376,760	3.3	3,333,280	1,666,640	3.2	8,297,127	4,012,058	6.2
New Mexico	3,765,000	2,402,070	54.5	213,483	136,202	1.1	2.831,585	1,879.331	37.0	3,016,772	1,924,215	48.4
New York	8,566,000	3,594,000	17.4	2,547,800	1,169,705	6.2	5,333,490	2,422,339	29.5	-----	-----	-----
North Carolina	1,972,000	812,330	24.3	1,032,730	449,595	4.8	2,427,765	1,101,790	20.3	198,420	87,200	2.0
North Dakota	99,800	53,820	.6	929,910	464,995	16.3	1,169,499	582,199	12.8	1,764,849	862,972	45.0

Ohio	7,715,000	3,232,000	4.1	1,602,374	801,187	.7	3.765,860	1,539,130	7.6	8,798,340	4,480,607	6.3
Oklahoma	4.200.000	2,212,510	16.2	629,000	321,404	7.9	907,700	479.084	6.4			
Oregon	1,753,000	1,059,000	19.4	252,262	152,000	.7	4,610,844	2,587,710	25.6	1,798,914	1,090,578	20.1
Pennsylvania	7,244,000	3,622,000	12.5				51,451,106	25,092,000	38.7	7,797,608	3,859,896	11.8
Rhode Island	3,036,000	1,518,000	5.3	47,800	19,900		887,700	295,900				
South Carolina	855,500	434,750	12.6				1,388,970	643,840	25.1	509.098	262,624	13.2
South Dakota	1,132.000	634,402	51.4	909,176	510,680	23.0	533,757	299,810	20.0	410,031	227,733	9.6
Tennessee	2,483,000	1,363,000	5.0	2,312,918	1,028,459	18.8	3,463,830	1,462,415	1.7	9,551,002	5.434.595	29.6
Texas	1,551,900	775,950	1.5	1,897,300	996,300	8.8	16,405,812	7,798,300	105.1	16,438,416	9.347,800	97.4
Utah	878,000	632,972	7.6	473,505	349,257	22.2	1,140,396	841,156	20.0	1.908,344	1,371.014	35.0
Vermont										282,947	135,193	1.4
Virginia	5,053,656	2,448,211	34.7	407,895	203,164	4.6	1,477,640	720,652	8.1	1.106,121	530,319	6.7
Washington	1,278,481	665,500	5.3	798,707	385,600	6.4	2,663,141	1,369.900	13.8	4,812,773	2,083.292	19.6
West Virginia	6,041,078	1,772,500	13.6	321,500	160,750	.1	1,371,070	717,410	2.3	627,264	262.058	3.0
Wisconsin	592,000	300,000	10.7	423,596	183,000	4.9	1,701,073	829,000	12.9	84,794	41.511	
Wyoming	1,157,502	752,081	23.1	192,964	104,518		1,859,266	1,287,587	53.2	2.705,712	1,735,058	63.2
District of Columbia	1,021,008	1,010,504	.4							10,198,988	5,038,651	2.0
Total	184,580,320	92,593,455	1,001.2	68,477,464	33,009.760	412.0	283,268,199	137,129,971	1.054.7	168,507.578	87,893.149	979.3

---

[1] Initial commitment of funds.

Table 12.—*Federal funds paid by Bureau of Public Roads during fiscal year ended June 30, 1950, by program and by State*

State or Territory	Postwar Federal-aid funds			Prewar Federal-aid funds			Defense highway funds	Emergency funds, 1933–35	Total
	Primary[1]	Secondary	Urban	Primary	Secondary	Grade crossing			
Alabama	$1,318,466	$2,650,423	$2,044,705	$91,714	$19,417	$62,313	$41,648	$7,315	$6,236,001
Arizona	2,929,993	1,892,205	95,215	1,568	5,999	4,126	5,507	----	4,934,613
Arkansas	2,526,235	2,340,117	760,283	18,673	----	276,179	----	----	5,921,487
California	5,727,055	4,686,678	5,359,879	175,163	----	317,923	585,139	----	16,851,837
Colorado	3,822,864	2,723,442	1,546,358	214,925	----	118,283	−7	----	8,425,865
Connecticut	749,715	535,664	2,691,177	----	1,940	410,681	12,925	67,546	4,469,648
Delaware	1,106,218	331,058	257,496	61,797	47,537	357,644	----	----	2,161,750
Florida	1,417,951	1,600,637	295,460	53,011	8,427	89,474	59,542	----	3,524,502
Georgia	4,319,759	4,248,333	1,852,392	665,874	74,524	332,698	113,206	212,491	11,819,277
Idaho	1,206,103	1,372,495	410,084	203,818	2,231	17,771	21,955	----	3,234,457
Illinois	8,107,690	2,986,313	4,659,401	----	18,455	557,359	47,332	----	16,376,550
Indiana	4,262,825	1,892,406	1,524,126	39,568	15,556	61,888	56,672	----	7,853,041
Iowa	7,287,334	4,958,580	625,627	11,954	12,924	88,214	61,224	----	13,045,857
Kansas	7,745,786	4,077,412	471,876	848,932	8,047	238,217	40,039	----	13,430,309
Kentucky	3,934,805	2,659,671	1,016,612	108,518	----	24,547	----	----	7,744,153
Louisiana	1,898,873	2,132,919	905,345	844,648	323,800	220,887	----	----	6,326,472
Maine	1,954,518	1,197,821	589,579	58,441	4,829	61,133	14,413	----	3,880,734
Maryland	1,635,960	843,695	3,115,522	----	1,223	132,028	87,867	----	5,816,295
Massachusetts	2,567,166	496,410	4,082,969	30,239	3,580	637,347	----	----	7,817,711
Michigan	6,472,434	3,451,834	6,557,232	12,110	33,600	45,081	----	----	16,572,291
Minnesota	5,753,125	2,725,908	1,639,735	167,111	81,257	738,939	19,736	----	11,125,811
Mississippi	2,540,514	2,678,749	605,837	171,312	15,558	108,858	9,849	----	6,130,677
Missouri	4,486,695	3,731,574	2,337,404	113,121	12,011	140,145	136,202	----	10,957,152
Montana	3,852,761	1,971,228	269,049	462,749	20,627	325,673	65,381	----	6,967,468
Nebraska	1,679,838	2,386,013	812,114	331,135	6,055	158,879	----	----	5,374,034
Nevada	2,673,954	1,427,420	13,017	79,807	15,285	104,855	−379	----	4,313,959
New Hampshire	512,086	311,539	438,557	18,736	----	21,260	----	----	1,302,178
New Jersey	2,123,085	877,770	6,850,101	47,399	201,524	142,280	----	----	10,242,159
New Mexico	3,384,949	1,677,855	77,991	----	19,324	158,310	−223	----	5,318,206
New York	13,339,862	4,325,298	11,693,359	59,691	40,062	1,949,271	22,437	201,206	31,631,186
North Carolina	3,076,776	3,400,948	1,373,052	160,083	87,488	323,272	141,182	----	8,562,801
North Dakota	4,019,098	1,344,800	88,278	189,051	446,363	321,591	11,897	----	6,421,078

Ohio	6, 255, 331	3, 594, 917	3, 326, 858	58, 911	154, 038	240, 380	19, 507		13, 649, 942
Oklahoma	6, 068, 555	3, 857, 403	462, 354	144, 591	140, 445	47, 818	13, 442		10, 734, 608
Oregon	4, 071, 197	1, 687, 844	849, 326	77, 013	134, 064		30, 261		6, 849, 705
Pennsylvania	5, 673, 968	3, 684, 589	9, 156, 197	93, 414	57, 998	124, 720	205, 311	457	18, 996, 654
Rhode Island	730, 863	201, 579	388, 376	111, 645	61, 460	39, 011			1, 532, 934
South Carolina	1, 945, 059	2, 085, 505	774, 360	21, 213	8, 281	271, 635	3, 703		5, 109, 756
South Dakota	3, 534, 962	1, 861, 840	37, 096	195, 819	520, 969	182, 060	42, 784		6, 375, 530
Tennessee	4, 794, 370	2, 751, 979	962, 908		69	14, 324			8, 523, 650
Texas	17, 314, 728	8, 412, 373	3, 602, 708			174, 935	36, 889		29, 541, 633
Utah	2, 705, 974	1, 075, 108	49, 129			7, 687	47, 209		3, 885, 107
Vermont	914, 099	446, 907	261, 785	958	108	16, 798			1, 640, 655
Virginia	2, 268, 919	2, 140, 165	289, 270	179. 750	501, 258	274, 399	1, 218, 919		6, 872, 680
Washington	2, 440, 666	1, 748, 339	1, 022, 073				81		5, 211. 159
West Virginia	1, 990, 184	1, 930, 918	604, 101	43, 414	8, 000		6, 403		4, 583. 020
Wisconsin	4, 361, 703	3, 332, 769	2, 366, 174	313, 221	96, 358	186, 788			10, 657, 013
Wyoming	2, 670, 950	2, 172, 480	1, 928	101, 300		7, 373			4, 954, 031
District of Columbia	[2] 2, 250, 394	[2] −340, 114	350, 680			6, 051			2, 267, 011
Hawaii	825, 142	291, 995	5, 901	322, 663	183, 003	−1, 218	229, 033		1, 856, 519
Puerto Rico	480, 251	628, 277	255, 270	118, 333	83. 556	15, 503	3, 204		1, 584, 394
Total	189, 731, 808	115, 502, 088	89, 826, 326	7, 023, 393	3, 477, 250	10, 155, 390	[3] 3, 413, 345	489, 015	[3] 419, 618, 615

---

[1] Funds available for either urban or rural portions of the Federal-aid highway system.

[2] Transfer of previous payments from postwar secondary funds to postwar primary funds.

[3] Total shown includes $3,055 of expenditures made during the year but not distributed by States.

Table 13.—*Balances of Federal funds available to States for projects not yet programed as of June 30, 1950*

State or territory	Postwar Federal-aid funds				Prewar Federal-aid funds				Total
	Primary [1]	Secondary	Urban	Total	Primary	Secondary	Grade crossing	Total	
Alabama	$9, 433, 897	$2, 724, 221	$1, 438, 597	$13, 596, 715			$18, 194	$18, 194	$13, 614, 909
Arizona	1, 085, 726	86, 953	252, 208	1, 424, 887					1, 424, 887
Arkansas	308, 288	1, 299, 676	240, 460	1, 848, 424					1, 848, 424
California	194, 619	2, 868, 487	123, 844	3, 186, 950			1, 120	1, 120	3, 188, 070
Colorado	1, 171, 594	1, 415, 883	411, 649	2, 999, 126			26, 711	26, 711	3, 025, 837
Connecticut	581, 994	841, 793	897, 448	2, 321, 235			2, 179	2, 179	2, 323, 414
Delaware	254, 473	450, 615	527, 992	1, 233, 080					1, 233, 080
Florida	468, 192	1, 623, 464	2, 733, 773	4, 825, 429	$110			110	4, 825, 539
Georgia	2, 381, 700	1, 350, 368	406, 773	4, 138, 841					4, 138, 841
Idaho	2, 434, 426	2, 303, 899	188, 176	4, 926, 501					4, 926, 501
Illinois	6, 244, 574	7, 332, 894	5, 231, 026	18, 808, 494			31	31	18, 808, 525
Indiana	6, 308, 042	4, 898, 179	5, 215, 589	16, 421, 810			108, 353	108, 353	16, 530, 163
Iowa	234, 695	436, 085	2, 612, 043	3, 282, 823					3, 282, 823
Kansas	434, 132	3, 478, 366	565, 643	4, 478, 141					4, 478, 141
Kentucky	397, 854	502, 768	1, 559, 187	2, 459, 809					2, 459, 809
Louisiana	1, 357, 336	1, 586, 399	2, 824, 164	5, 767, 899	636			636	5, 768, 535
Maine	219, 353	477, 605	1, 159, 183	1, 856, 141			414	414	1, 856, 555
Maryland	90, 500	1, 611, 609	305, 274	2, 007, 383					2, 007, 383
Massachusetts	157, 267	342, 168	1, 814, 616	2, 314, 051					2, 314, 051
Michigan	3, 077, 206	2, 538, 083	1, 353, 970	6, 969, 259					6, 969, 259
Minnesota	312, 935	1, 527, 705	529, 873	2, 370, 513					2, 370, 513
Mississippi	6, 303, 552	3, 459, 883	1, 174, 725	10, 938, 160					10, 938, 160
Missouri	1, 803, 625	4, 451, 970	906, 094	7, 161, 689					7, 161, 689
Montana	927, 977	3, 782, 136	610, 247	5, 320, 360					5, 320, 360
Nebraska	1, 445, 959	2, 982, 867	869, 206	5, 298, 032					5, 298, 032
Nevada	1, 219, 259	363, 802	53, 853	1. 636, 914			48	48	1, 636, 962
New Hampshire	448, 649	418, 458	906, 907	1, 774, 014					1, 774, 014
New Jersey	585, 691	914, 361	1, 059, 876	2, 559, 928					2, 559, 928
New Mexico	532, 733	196, 516	586, 703	1, 315, 952					1, 315, 952
New York	5, 279, 889	4, 250, 323	24, 628, 387	34, 158, 599					34, 158, 599
North Carolina	731, 912	2, 140, 384	587, 604	3, 459, 900	163			163	3, 460, 063
North Dakota	1, 376, 106	2, 059, 660	505, 841	3, 941, 607					3, 941, 607

Ohio	284, 398	2, 766, 984	5, 481, 328	8, 532, 710					8, 532, 710
Oklahoma	272, 484	584, 806	39, 308	896, 598			60, 286	60, 286	956, 884
Oregon	585, 084	228, 046	168, 518	981, 648					981, 648
Pennsylvania	2, 046, 760	823, 798	1, 422, 994	4, 293, 552					4, 293, 552
Rhode Island	40, 517	80, 664		121, 181					121, 181
South Carolina	2, 678, 368	215, 226	210, 485	3, 104, 079					3, 104, 079
South Dakota	444, 326	282, 207	566, 736	1, 293, 269	1, 134			1, 134	1, 294, 403
Tennessee	219, 297	753, 433	167, 128	1, 139, 858					1, 139, 858
Texas	6, 214, 294	486, 914	3, 130, 824	9, 832, 032			22, 365	22, 365	9, 854, 397
Utah	352, 767	343, 997	884, 240	1, 581, 004			7, 027	7, 027	1, 588, 031
Vermont	271, 423	671, 475	471, 586	1, 414, 484					1, 414, 484
Virginia	948, 159	1, 191, 439	3, 362, 660	5, 502, 258					5, 502, 258
Washington	1, 080, 163	256, 998	560, 878	1, 898, 039					1, 898, 039
West Virginia	1, 421, 430	70, 745	654, 174	2, 146, 349					2, 146, 349
Wisconsin	1, 246, 865	3, 808, 957	3, 468, 964	8, 524, 786			356	356	8, 525, 142
Wyoming	302, 089	338, 390	209, 721	850, 200					850, 200
District of Columbia	388, 908	198, 791	1, 018, 601	1, 606, 300					1, 606, 300
Hawaii	409, 757	611, 770	296, 035	1, 317, 562			188, 075	188, 075	1, 505, 637
Puerto Rico	1, 212, 846	2, 360, 258	2, 028, 218	5, 601, 322		$13, 390		13, 390	5, 614, 712
Total	78, 224, 090	80, 792, 478	86, 423, 329	245, 439, 897	2, 043	13, 390	435, 159	450, 592	245, 890, 489

---

[1] Funds available for either urban or rural portions of the Federal-aid highway system.

Table 14.—*Average number* [1] *of persons employed on Bureaus of Public Roads and State highway construction and maintenance, United States and Territories, by program and by month, for fiscal year ended June 30, 1950*

Year and month	Construction programs					Road maintenance by State highway departments	Total construction and maintenance
	Postwar Federal-aid programs	Prewar Federal-aid programs	Federal forests, parks, public lands, flood relief, and miscellaneous	Total Federal programs	State highways, with State funds only		
1949							
July	86,591	1,627	5,998	94,216	51,121	124,931	270,268
August	86,635	1,325	6,485	94,445	51,699	128,631	274,775
September	84,569	1,397	6,371	92,337	51,248	125,032	268,617
October	83,045	1,551	6,037	90,633	47,338	122,022	259,993
November	61,969	1,144	4,674	67,787	39,612	120,798	228,197
December	43,063	783	3,162	47,008	28,930	117,587	193,525
1950							
January	30,918	577	1,988	33,483	21,120	115,154	169,757
February	31,064	518	1,852	33,434	19,420	114,714	167,568
March	37,300	536	2,115	39,951	23,396	114,891	178,238
April	48,915	609	2,595	52,119	30,243	116,980	199,342
May	66,056	825	3,342	70,223	38,733	121,802	230,758
June	76,483	967	4,111	81,561	47,490	128,470	257,521

[1] Average number of persons employed is computed as the mean of the weekly payroll counts made during the calendar month.

Table 15.—*Mileage of designated Federal-aid systems, by State, as of June 30, 1950*

State or Territory	Federal-aid highway system			Federal-aid secondary system
	Total	In rural areas PRIMARY	In urban areas URBAN	SECONDARY
	Miles	*Miles*	*Miles*	*Miles*
Alabama	5, 017	4, 805	212	10, 468
Arizona	2, 487	2, 447	40	2, 728
Arkansas	3, 486	3, 357	129	12, 937
California	7, 087	6, 435	652	9, 148
Colorado	4, 019	3, 925	94	3, 681
Connecticut	1, 092	805	287	1, 104
Delaware	528	501	27	1, 246
Florida	3, 967	3, 625	342	7, 203
Georgia	7, 045	6, 743	302	12, 288
Idaho	3, 474	3, 434	40	3, 104
Illinois	10, 327	9, 351	976	7, 285
Indiana	4, 831	4, 271	560	8, 790
Iowa	9, 675	9, 334	341	33, 024
Kansas	8, 576	8, 407	169	19, 927
Kentucky	3, 855	3, 665	190	10, 561
Louisiana	2, 674	2, 452	222	5, 596
Maine	1, 626	1, 532	94	2, 269
Maryland	1, 856	1, 668	188	5, 193
Massachusetts	2, 048	1, 132	916	2, 173
Michigan	6, 483	6, 008	475	12, 892
Minnesota	7, 394	6, 938	456	14, 418
Mississippi	4, 405	4, 251	154	7, 283
Missouri	8, 280	8, 058	222	12, 558
Montana	5, 760	5, 698	62	3, 090
Nebraska	5, 552	5, 438	114	9, 958
Nevada	2, 203	2, 177	26	2, 001
New Hampshire	1, 171	1, 064	107	1, 078
New Jersey	1, 731	1, 176	555	1, 912
New Mexico	4, 082	4, 018	64	4, 135
New York	10, 403	9, 279	1, 124	19, 070
North Carolina	7, 959	7, 603	356	8, 204
North Dakota	3, 294	3, 250	44	10, 321
Ohio	7, 508	6, 632	876	12, 244
Oklahoma	7, 404	7, 205	199	10, 600
Oregon	3, 905	3, 767	138	4, 472
Pennsylvania	7, 896	6, 680	1, 216	10, 685
Rhode Island	460	244	216	322
South Carolina	4, 412	4, 216	196	9, 833
South Dakota	4, 270	4, 203	67	10, 826
Tennessee	5, 014	4, 795	219	6, 417
Texas	15, 932	15, 317	615	20, 095
Utah	2, 265	2, 199	66	2, 906
Vermont	1, 238	1, 180	58	1, 770
Virginia	5, 114	4, 867	247	16, 465
Washington	3, 555	3, 382	173	6, 232
West Virginia	2, 393	2, 190	203	10, 994
Wisconsin	6, 044	5, 679	365	13, 517
Wyoming	3, 426	3, 395	31	1, 687
District of Columbia	135	------------	135	57
Hawaii	563	535	28	542
Puerto Rico	565	443	122	958
Total	234, 486	219, 776	14, 710	406, 267

Table 16.—*Status of National forest highway projects as of June 30, 1950, and projects completed during the fiscal year* [1]

State or Territory	Programed, [2] construction not yet authorized			Construction authorized, not started			Under construction			Completed during fiscal year		
	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles	Total cost	Federal funds	Miles
Alabama										$550, 754	$400, 184	28. 0
Arizona	$575, 000	$575, 000	13. 5				$2, 247, 684	$2, 247, 684	54. 5	970, 465	970, 465	24. 1
Arkansas	326, 891	326, 891	24. 9				283, 374	283, 374	4. 9	417, 067	417, 067	8. 8
California	1, 983, 500	1. 983, 500	14. 5	$441, 500	$441, 500	23. 6	3, 191, 000	3, 181, 300	50. 8	3, 716, 934	3, 682, 684	63. 4
Colorado	1, 160, 000	1, 160, 000	45. 9	274, 000	274, 000	2. 2	3. 417, 000	3, 417, 000	58. 8	289, 250	289, 250	5. 6
Florida	413, 924	206, 962	15. 0				317, 230	158, 615	18. 7			
Georgia	80, 206	80, 206	14. 5				317, 734	158, 783	13. 8	267, 656	133, 828	6. 3
Idaho	2, 185, 000	2, 185, 000	38. 1	530, 000	530, 000	4. 6	3. 352, 000	3. 352, 000	61. 3	2, 763, 900	2, 609, 200	80. 7
Illinois	139, 000	69, 500	3. 7	60, 721	30, 360	3. 7						
Indiana	136, 000	59, 977	. 2									
Louisiana				330, 460	165, 230	1. 8				95, 427	44, 955	. 6
Maine										44, 213	44, 213	7. 6
Michigan	525, 000	262, 500	16. 6				226, 000	226, 000	17. 5	566, 497	404, 397	33. 0
Minnesota							787, 215	587, 010	35. 7			
Mississippi	98, 585	49, 292	10. 6				230. 100	115, 050	10. 7	175, 052	175, 052	6. 9
Missouri	317, 308	317, 308	15. 1	39, 344	39. 344	3. 3	93, 104	93, 104	3. 0	166, 651	166, 651	7. 2
Montana	1, 816, 250	1, 816, 250	22. 8	1, 375, 750	1, 375, 750	37. 7	1, 134, 500	1, 134, 500	51. 0	1, 133, 000	1, 130, 000	78. 5
Nebraska	46, 406	46, 406	10. 2	95, 930	95, 930	. 1						
Nevada	324, 000	324, 000	3. 7	341, 000	341, 000	2. 8	232, 000	232, 000	4. 5	627, 100	554, 500	16. 8
New Hampshire				43, 600	42, 000	. 1	334, 000	334, 000	4. 2	258, 592	258, 592	3. 2
New Mexico	770, 000	770, 000	19. 1				411, 000	411, 000	2. 0	1, 031, 000	1, 031, 000	18. 0
North Carolina	630, 000	315, 000	12. 8									
Oklahoma	57, 660	28, 830										
Oregon	2, 576, 000	2, 370, 280	31. 7	1, 076, 000	1, 070, 720	36. 9	5, 951, 000	4, 992, 623	113. 6	2, 913, 989	2. 810, 989	40. 3
Pennsylvania	240. 000	145, 000	7. 4				220, 800	179, 800	8. 9			
South Carolina				15, 200	5, 844		284, 800	135, 439	14. 9	261, 167	105, 783	8. 4
South Dakota				150, 000	150, 000	3. 1	167, 000	167, 000	3. 7	147, 500	147, 500	5. 9
Tennessee	400, 000	200, 000	11. 8	232, 866	116, 433	3. 4	178, 793	89, 397	3. 3			

Texas	289,600	144,800	4.4				120,000	60,000	7.3			
Utah	606,000	606,000	16.2	127,000	127,000	6.2	1,114,900	1,114,900	35.5	416,693	401,693	15.6
Vermont	35,000	35,000	.5				142,487	71,000	2.7			
Virginia	37,500	37,500	1.5	39,076	19,538	1.2	401,012	361,256	9.8	201,357	158,029	22.9
Washington	1,140,000	1,140,000	39.3	451,000	451,000	13.0	1,024,000	1,024,000	29.9	1,721,700	1,721,700	28.5
West Virginia	295,124	147,562	4.9	90,000	45,000		141,100	141,100	7.7			
Wisconsin	30,000	30,000	1.0	140,548	132,548	10.3				245,381	239,781	9.1
Wyoming	460,000	460,000	21.8	457,000	457,000	7.9	2,214,000	2,214,000	28.8	224,000	224,000	6.3
Alaska	48,000	48,000		463,000	463,000	5.5	1,504,000	1,504,000	15.9	976,020	976,020	15.7
Total	17,741,954	15,940,764	421.7	6,773,995	6,373,197	167.4	30,037,833	27,985,935	673.4	20,181,365	19,097,533	541.4

---

[1] Includes construction projects only.
[2] Initial commitment of funds.

Table 17.—*Mileage of the National forest highway system, by forest road class and by State, as of June 30, 1950*

Region and State or Territory	Total	Class 1 [1]	Class 2 [2]	Class 3 [3]
Western region:	*Miles*	*Miles*	*Miles*	*Miles*
Arizona	1,060.1	405.4	199.4	455.3
California	2,456.1	677.8	1,233.0	545.3
Colorado	1,743.0	621.0	1,077.0	45.0
Idaho	1,129.8	690.8	229.9	209.1
Montana	1,190.5	694.3	238.1	258.1
Nevada	313.7	157.2	155.5	1.0
New Mexico	672.0	160.0	512.0	-----
Oregon	1,381.8	716.8	446.4	218.6
South Dakota	308.0	187.0	49.0	72.0
Utah	697.0	188.2	441.4	67.4
Washington	751.4	387.7	123.1	240.6
Wyoming	545.0	380.0	140.0	25.0
Alaska	356.3	-----	-----	356.3
Total	12,604.7	5,266.2	4,844.8	2,493.7
Eastern region:				
Alabama	250.8	105.8	83.9	61.1
Arkansas	633.6	111.6	522.0	-----
Florida	165.0	3.0	162.0	-----
Georgia	258.6	141.6	91.7	25.3
Illinois	305.3	245.8	15.0	44.5
Indiana	101.2	53.6	42.1	5.5
Kentucky	352.7	129.5	110.9	112.3
Louisiana	403.1	66.1	337.0	-----
Maine	14.0	-----	3.3	10.7
Michigan	1,183.3	588.7	329.5	265.1
Minnesota	718.8	256.5	192.2	270.1
Mississippi	509.4	201.3	250.4	57.7
Missouri	980.3	399.2	212.9	368.2
Nebraska	30.4	-----	-----	30.4
New Hampshire	166.0	40.9	92.1	33.0
North Carolina	797.5	452.8	267.7	77.0
Ohio	123.9	70.4	37.7	15.8
Oklahoma	48.5	31.5	17.0	-----
Pennsylvania	375.7	123.8	233.0	18.9
South Carolina	353.2	231.0	122.2	-----
Tennessee	348.3	165.1	147.7	35.5
Texas	307.2	129.2	170.5	7.5
Vermont	118.5	32.7	43.2	42.6
Virginia	1,349.2	413.7	527.2	408.3
West Virginia	408.0	60.0	245.9	102.1
Wisconsin	432.4	76.7	209.8	145.9
Puerto Rico	36.0	-----	-----	36.0
Total	10,770.9	4,130.5	4,466.9	2,173.5
Grand total	23,375.6	9,396.7	9,311.7	4,667.2

---

[1] Class 1.—Forest roads forming sections of the Federal-aid highway system, either wholly within or, when so designated by the Secretary of Agriculture and the Secretary of Commerce, partly without and adjacent to the National forests.

[2] Class 2.—Forest roads, not of class 1, which are parts of approved State highway systems, when so designated by the Secretary of Agriculture and the Secretary of Commerce.

[3] Class 3.—All forest highways on the secondary or feeder road system and any other forest road, of primary importance to the counties or communities, when designated as a forest highway.

Table 18.—*Mileage of highways in or leading to National parks, monuments, and parkways, by construction status and by area, as of June 30, 1950*

Park, monument, or parkway (and State)	Total completed as of June 30, 1950	Completed during fiscal year ended June 30, 1950			Under construction as of June 30, 1950
		Total	Initial improvement	Stage construction	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*
Acadia (Maine)	31.3				0.5
Badlands (S. Dak.)	22.0	22.0		22.0	
Bandelier (N. Mex.)					
Big Bend (Tex.)					7.7
Blue Ridge (Va.-N. C.)	327.3	58.5	0.3	58.2	91.0
Bryce Canyon (Utah)	21.7				
Carlsbad Caverns (N. Mex.)	8.4	8.4		8.4	
Chalmette (La.)	.5				
Chickamauga-Chattanooga (Ga.-Tenn.)	9.4				
Colonial (Va.)	12.2				
Crater Lake (Oreg.)	65.9				
Devils Tower (Wyo.)	.3				
Fort Donelson (Tenn.)	2.8				
Fort Matanzas (Fla.)	.5				
Fort Pulaski (Ga.)	.3				
Fredericksburg-Spotsylvania (Va.)	23.1				
George Washington Birthplace (Va.)	2.6				
George Washington Memorial (Va.-Md.)	14.2	.2	.2		1.6
Gettysburg (Pa.)	9.5				
Glacier (Mont.)	73.4				9.9
Grand Canyon (Ariz.)	193.0				
Great Smoky Mountains (N. C.-Tenn.)	38.5				15.4
Guilford Court House (N. C.)	2.6				
Hawaii (T. H.)	35.5				
Hot Springs (Ark.)	3.6				
Kill Devil Hill (N. C.)	1.6				
Kings Canyon (Calif.)	22.7				4.0
Lake Mead (Ariz.-Nev.)	42.6				
Lassen Volcanic (Calif.)	35.1				30.4
Meriwether Lewis (Tenn.)	1.8				
Mesa Verde (Colo.)	31.9				
Morristown (N. J.)	2.7				
Mount Rainier (Wash.)	90.8				.9
Natchez Trace (Miss.-Tenn.-N. C.)	128.9	47.7	26.0	21.7	40.1
National Capital Parks (D. C.-Va.-Md.)	5.3				.1
Organ Pipe Cactus (Ariz.)	22.7				
Petersburg (Va.)	8.7				4.1
Petrified Forest (Ariz.)	31.1				
Rocky Mountain (Colo.)	54.2	2.7		2.7	
Scotts Bluff (Nebr.)	1.6				
Sequoia (Calif.)	42.7				
Shenandoah (Va.)	96.9	.3		.3	12.3
Shiloh (Tenn.)	10.6				
Suitland (Md.)	8.9	.4	.4		
Vicksburg (Miss.)	10.4				
Wind Cave (S. Dak.)	15.9				
Yellowstone (Wyo.-Mont.-Idaho)	321.9				15.3
Yosemite (Calif.)	108.7	18.3		18.3	
Zion (Utah)	41.6	11.5		11.5	
Total	2,037.9	170.0	26.9	143.1	233.3

Table 19.—*Mileage of approach roads to National parks and monuments, by construction status and by location, as of June 30, 1950*

Road	Park	Designated	Under construction	Completed
		Miles	*Miles*	*Miles*
Cameron-Desert View	Grand Canyon	28.1		28.1
South Approach	do	52.3		52.3
Jacobs Lake-North Rim	do	31.2		30.9
Mineral-Lassen Volcanic	Lassen Volcanic	8.8		4.7 [1] 4.1
Fresno-Kings Canyon	Kings Canyon	11.3		11.3
Sequoia-Kings Canyon	Sequoia-Kings Canyon	10.4		10.4
Custer-Wind Cave	Wind Cave	8.6		8.6
Southwest Approach	Yellowstone	13.9		13.9
Moran-Yellowstone	do	24.0	15.3	4.5
Red Lodge-Cooke City	do	59.7		59.7
East Approach	do	23.0		22.9
Zion-Bryce Canyon	Zion-Bryce Canyon	31.3		22.9
Cedar Breaks	Cedar Breaks	2.6		
Total		305.2	15.3	270.2

[1] Graded as a forest-road project. Figure not included in total.

○

JUL 9 1956